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Electrical World

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Public Benefits from Interconnection

INTERCONNECTION, when the object is the delivery of energy throughout a given area at the lowest total cost consistent with high-class service, is certainly a progressive development. Fondness for old landmarks has no economic justification in such a scheme, and the wasteful use of labor, fuel or water is indefensible. It is no criticism of an interconnection if the use made of it changes as time passes. At the outset, no doubt, emphasis is naturally laid upon the possibilities of interchange afforded, and the first year or two of service may show more or less give and take between the plants concerned. The smaller stations, however, tend soon to reach the limits of their capacity for economical service, while the larger plants, and especially those located on tidewater or otherwise suited to expansion on a large scale, usually meet no such limitations. Pretty soon it comes to pass that many good-sized communities find themselves electrical way stations in the operating scheme. So long as the minimum cost per unit of energy delivered over the area included is realized, however, it should be a matter of indifference to the general public whether energy is fed over the lines in one direction or another, and by acquainting himself with these cost factors in the local or regional problem the central-station or transmission system manager takes the best possible means of meeting the inquiries and the unjustified deductions which may be made by influential interests for political capital or other biased purposes from the results of his operating scheme. It is not enough to rest content with the knowledge that an interconnection is technically workable. The translation of its results and possibilities into economic terms appealing to the layman may be quite as important to its permanent success.

Application of Benjamin Franklin's old saying, "If you want a man to be your friend get him to do you a favor," has been found in utility management circles. A manager who succeeded in getting his public to vote him a rate increase finds that his company gained friends in the process.

Rural Electric Service Rates

IT HAS taken five years for the central-station industry as a whole to discover and openly to declare that electric service rates in the country must be higher than they are in town. Progress can be made from now on, however, if this difference in the cost of country and city service is honestly recognized and steps are taken to work out and publicly file fair rural rates.

As to what type of rate is best, this seems certain. The minimum charge, or service charge as it might better be called, should be considerably higher than that now effective in most cities. Service charges of from $5 to $8 a month do not seem unreasonable for rural electric service. Such a charge would benefit the farmer himself. He is usually so constituted mentally that he persists in watching the meter in order to stay within his minimum bill, regardless of what it may be. This often curtails the use of service to such a point that his benefits from it are not proportional to the fixed investment which he makes to secure electric service. A higher minimum would encourage him to use enough service to make his electrical investment really profitable to him.

Besides benefiting the farmer, a higher minimum charge is necessary from the central-station standpoint. It can be and has been justified by the cost of service, when the higher investment and maintenance charges, losses and the on-peak, low-diversity factor characteristics of the business are considered. Moreover, if the competitive costs of electric service from gasoline-engine storage-battery plants are considered it can be shown that a service charge of $90 a year is not excessive.

It appears, therefore, that the rate makers of the industry should promptly shoulder the responsibility of finding an early answer to the rural rate problem. The farmers want the service and are willing to pay for it. The central stations are willing to serve the load if it can be served profitably. A proper rate is all that is lacking.

The attitude of a community toward its electric utility will usually be reflected in the attitude of the state regulatory body toward the company. As the public thinks so will the commission tend to decide. The good will of the community is therefore a great asset to any utility.

The Way Out, Not to Strike but to Work

THE world-famed "Tiger" of France, Premier Clemenceau, has declared, according to recent cable dispatches, that the solution of present industrial difficulties lies in a simple word of four letters—work. With characteristic simplicity and broad vision he appeals, in terms clearly understood, to intelligent men in all civilized countries. In these days of strikes and all too frequent curtailment of output it is profoundly significant that even the Russian Bolsheviki have been forced to acknowledge their dependence upon increased production. According to the London *Economist* of Oct. 4, Soviet Russia has begun to learn the fallacies of the six-hour day, "vacations" from factory, store and farm, limitation of output, the abolition of currency, and a few other economic vagaries dear to the distorted intellect of the advanced communist.

It appears that the Bolsheviki are rapidly being driven

away from the regime of barter as a possible means of trade outside their territory and that all over Russia the system of forced production by order of the State and along the lines of the old capitalistic methods in the interest of state finances is making headway. Last June the six-hour day was abolished and replaced by one of eight hours, and forty-eight and sixty-six hours were decreed as the weekly working terms in industry and agriculture respectively. On Moscow factory walls are hung compulsory ordinances aimed at forcing production, with a schedule of penalties, one of which is a transference to a low-rations class. The Commissary of Communications is denounced by advanced communist writers for compelling men to work fourteen hours a day, and the few revolts against the system of compelling increased production, notably at the Bogatyr rubber works, have failed.

The significance of these tendencies should not be overlooked in American industry. That argument should be required to demonstrate to this distressed age that the way out of the present economic morass is the path of production seems almost absurd. If all toilers, whether by brain or by hand, would dedicate their energies to this cause with a quarter of the loyalty which they so cheerfully devoted to winning the great war against the forces of evil, the unrest of the day would be driven out of its trenches into the open and would gradually be reduced to the point where contentment and prosperity would be the portion of millions who now fail to see how curtailment of output is holding back the new and better days sure to come as the light of understanding dawns in thinking minds.

Foresight exercised in the purchase of coal lands looms large among the factors that have permitted some central stations to safeguard their patrons against increased electric service rates. Where this is true the patrons should be apprised of the facts so that they will be willing to permit the company to share in the saving that came from good management.

Maintaining Plant with 3000 Motors

WE ARE glad to present this week an account of the electric motor service in the Naumkeag Mills at Salem, Mass., which, we believe, utilize the greatest number of electric motors, big and little, to be found in any plant yet constructed. When one considers that the floor space of these cotton mills runs to more than 20 acres (8 hectares), with more than 3000 motors in regular operation, some idea of the magnitude of the plant may be obtained. There are, of course, various plants using motors of higher aggregate output, but if there is one superior in the total number of motors we shall be interested to hear of it. The use of individual motors of 0.5 hp. and 0.75 hp. for the looms accounts in the main for the prodigious number of units. It is worth noting that all these small motors are of the type with cast-aluminum rotor windings, if such a conducting system can be called a winding at all. The inspection and maintenance of the installation is numerically a serious task, but physically the results have been of exceptional excellence, since in nearly five years only four motors have been replaced. The weave shed shows 97.5 per cent of its theoretical production and the spinning mill 96 per cent. Occasionally fuses blow, but the four maintenance men and the oiler who are constantly on the job have reduced stoppages from this cause to a minimum, and if anything happens the trouble is generally remedied within ten minutes. Owing to the proximity to the source of supply of motors and auxiliaries, the number of spare parts carried in stock for the whole installation is very small, the stock room and electrician's office together taking a space of only 24 feet by 25 feet (7.2 m. by 10.5 m.) in the basement of the wheel shed. The power for the whole installation is derived from the local central station. A far cry, all this, from the group drive of the electrically operated cotton mills of five-and-twenty years ago, but an admirable proof of the continuing and increasing efficiency and reliability of electric power.

The possibilities of industrial electric heating should not be overlooked in the present wonderful trade being handled in domestic appliances. Now is the time to organize for continuous study of local manufacturing-plant conditions favorable to the introduction of electric welding, restricted volume heating, automatic temperature maintenance with or without other agencies of heat supply, and low-wattage applications. Too few thorough surveys of this kind are in the hands of central-station power sales departments.

Research a National Asset

THERE is abundant evidence that our national supremacy in the industries depends to a very considerable degree upon the research development in this country, and much thought has been given to some program for encouragement and adequate support of the work. A broad policy of education is necessary, not only for the benefit of the general public but also among those responsible for the industries themselves, before the nation may be assured of a leading position in science and industry.

There are two important phases in the extension of research, (1) the creation of public sentiment recognizing the importance of scientific work and (2) the training of men to do the work.

In the larger industries it might be said that the necessity for research development is fully appreciated and established, but it should be realized that the responsibility is far too great to be carried by a few large industrial concerns. The work must be extended to the smallest industry, and the efforts of a large number of independent research workers should be supported.

For the training of men the university is pre-eminently the best place to develop the high-grade research workers, and much may be done to bring home to the people who support the universities in this work the great importance of it. The investment should net returns of a very high order, even leaving out of consideration the broad aspect of benefiting the world in which we live. The very important part taken by college men, especially men of science and engineering, in the Great War has been generally recognized, and this is an important step in the general appreciation of science and research which is so necessary if the nation is to hold its place in world-wide commerce. Our efforts must be directed toward building upon this foundation.

The larger industries are, generally speaking, alive to their responsibilities in the support of educational and research work, and they have already adopted some meas-

ures for this purpose. There does not appear to be any organized plan for supporting purely scientific work among the industries as yet, but the right spirit is there, and it would appear that some such agency as the National Research Council should co-ordinate these individual efforts.

Last month at Philadelphia there occurred a joint meeting of the American Institute of Electrical Engineers and the American Physical Society which was devoted not only to the discussion of specific problems in research but also to the consideration of its general advancement. The arrangement proved a happy one, tending to promote mutual appreciation between the scientists and the applied scientists. Pure scientists are encouraged by seeing their dreams turned into realities, while engineering progress would be greatly diminished without the researches in physics and chemistry. If the A. I. E. E. shall continue to devote the Philadelphia meeting to the cause of research, a better understanding of the importance of the work should result.

Many of the difficulties between employer and employee arise from the failure of subordinates to carry out the policies of the management in dealing with workmen. The selection and supervision of foremen is of great importance and is vital to the morale of any industrial establishment.

Electric Ovens for Japanning

WE ARE glad to have been able to give in our last issue some details regarding the use of electric baking ovens as a substitute for the gas oven of earlier practice. The work referred to is being done in the factory of the Royal Typewriter Company, which is one of the many plants obtaining power from the Hartford Light Company. The particular oven here considered is of the conveyor type with heating capacity for turning out a ton of typewriter parts per hour. The parts are hung on endless chains and pass successively through a warm dipping tank, a drip chamber and the baking oven proper. One of the notable advantages of the apparatus is the complete control of temperature which is furnished by an electric thermostat operating magnetic switches which in turn control the heating elements. Since the proper baking temperature depends on the particular material to be dealt with, such an accurately regulated automatic control is valuable.

In the practical operation of the ovens it is found that their output is more uniform as to quality than the work of gas ovens, and there is decidedly increased capacity for the space taken up. The first advantage is notably due to the great uniformity of the heat obtained, which removes all danger of overbaking, besides which the gas-fired furnaces occasionally ignited the drip and spoiled the contents of the oven, a danger entirely obviated in the electric heating. Finally, the electric baking is cheaper than the operation of the equivalent gas ovens. Under actual test the consumption of energy in the oven during the entire baking period amounted to a scant tenth of a kilowatt-hour per pound of parts treated, which well bespeaks the moderate cost of the operation. The last finishing coats of enamel are also applied in electric ovens previously in use but not forming a part of the continuously moving apparatus here described. Eventually it may be possible to make the entire operation continuous.

The Functions of the Load Dispatcher

AS THE complication of central-station distribution has increased the load dispatcher has become a more and more important functionary, rising from something little more than a judicious operator to the rank of the real operating engineer of the distributing service. Frank Gillooly's account of the load-dispatching work of the Philadelphia Electric Company last week gave a vivid idea of what the term really means and how great responsibility must rest on the man who has the task in hand. It is the duty of the load dispatcher to operate the network of the system and the units which feed it so as to give the best possible service at the highest efficiency. On him must rest the responsibility of determining how the load shall be carried and for what load preparations must be made all through an intricate system. In the case of the Philadelphia plant there is nearly 4000 miles of wire, fed by ten generating stations, twenty-eight substations in the regular service of the company and forty-five industrial substations. Now, to deal with this complex situation the load dispatcher must know the actual load and the possible demand all over the system, and these quantities bear direct relation to the season, the weather, the kind of industrial service undertaken and the previous history of the demands. No two days will be exactly alike, although there is a generic similarity between the results obtained in successive seasons.

Further, the load dispatcher must take cognizance of the wandering of the load, that most puzzling of all distribution phenomena. Hence he must have at hand, and continually fall back on, the log books of the load dispatcher's office which bring the data to his hand. These now run back in the Philadelphia plant for nine years and have been kept up to date so that the load dispatcher can make at least an intelligent forecast of what is likely on general principles to break loose, although even so he must be prepared to keep an eye cocked to the weather and act quickly if occasion requires, for a sudden storm has been known to pile on load at the rate of 1000 kw. or so a minute up to nearly peak value. In the log book, too, are accumulated all failures and apparatus troubles arising from wrong operation, changes in plant and addition of equipment, so that if the operator be of a statistical turn of mind a vast amount of valuable information aside from the mere day's work is disclosed. Since on the load dispatcher falls the responsibility of ordering units into and out of service he must keep up a close and intimate knowledge of just what is available and what is temporarily out of service so that the loading of a system can be shifted to meet the requirements. Reports of troubles therefore of every sort center around the load dispatcher's office for his information, and from him go all the necessary orders to make good in the minimum possible time. It goes without saying therefore that the load dispatchers have to be thoroughly conversant with the details of the equipment and operation of the system, and a long period of training is required before the necessary facts are at their finger tips.

The men of the load-dispatching staff are selected from the more responsible generating station positions and must have had previous experience in the station and at construction work in order fully to grasp their new responsibilities, of which this brief sketch gives only a conspective idea, the detail of which must be sought in Mr. Gillooly's study of the load-dispatching situation viewed as a whole.

European Power Plant Practice—II

A Study of European Plants Indicates New Lines for Development in This Country and Also Shows Where American Engineers and Manufacturers Might Extend Operations—Few Outdoor Substations in Western Europe

BY STEPHEN Q. HAYES
Engineering Department Westinghouse Electric & Manufacturing Company

GENERAL station arrangement, switching devices and insulators were dealt with in the previous article published in the ELECTRICAL WORLD for Sept. 6, 1919. The discussion of European plants is completed in this paper, which covers protective devices, switchboards and transformer practice as observed by the writer in western Europe. The absence of electrolytic lightning arresters and the considerable use of water jets are noteworthy features of protective schemes. The use of draw-out and sheet-metal-inclosed switchboards has possibly become more general abroad than in this country. In the matter of power transformers the core type is commonly used to facilitate repairs, and some very high efficiency units are in use.

European practice in connection with protection against lightning and other static disturbances has not been crystallized to the same extent as in America. Possibly this has been due to the comparatively large number of electrical manufacturers in Europe established in different countries and working along different lines of design. The European companies affiliated with the American General Electric and the American Westinghouse companies have in many cases followed American design or occasionally used American equipment.

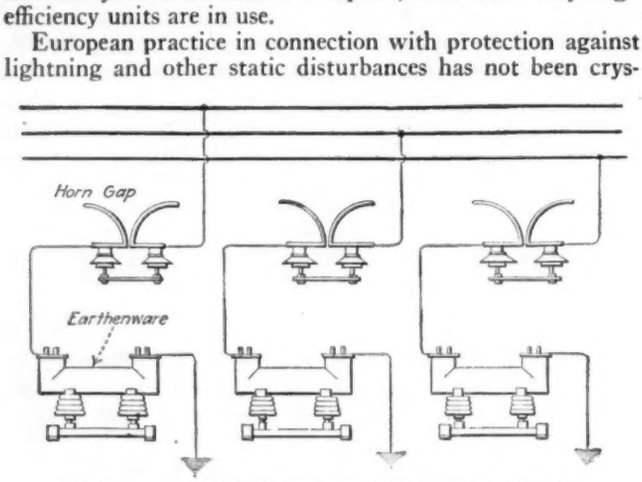


FIG. 1—ALIOTH HORN-GAP ARRESTER WITH WATER RESISTANCE

The non-arcing cylinders of the Wirts design have been used in a number of cases for moderate voltage plants in Europe, either alone or in connection with horn gaps or other types of arresters. Electrolytic lightning arresters, however, have not been used to any large extent in Europe, although listed and built by the A. E. G. company and the various Thomson-Houston and Westinghouse companies in Europe. The Savona station in Italy contains some A. E. G. electrolytic arresters without charging resistances and with the horns mounted on and operated from the roof. The electrolytic arrester itself, with the aluminum trays, tanks, etc., is installed indoors.

Most of the lightning arresters employed in Europe are of the horn type used with resistances of various kinds. In addition to these arresters, leakage paths to earth are frequently provided in the form of static condensers, water jet dischargers or leakage coils of different kinds.

The Alioth company usually employs horn-type arresters with liquid resistances arranged practically as shown in Fig. 3. The containers for the liquid resistance are made of pottery and are usually mounted on insulators for high-voltage service. To avoid having frequently to change the water in the liquid resistors owing to vegetable growth a small amount of corrosive sublimate is added, approximately half a grain per 100 liters.

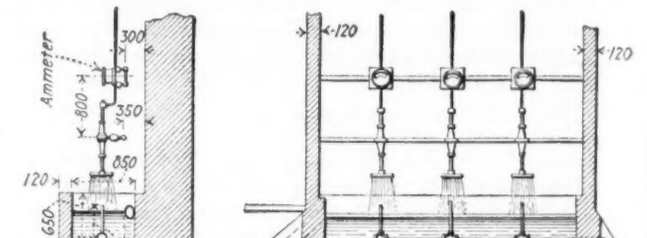


FIG. 2—WATER JET FOR DISCHARGING STATIC ACCUMULATION ON THE LINE

Where the arrester is exposed to frequent and powerful discharges, arrangements are sometimes made to have the water circulate in order to carry off the heat developed by these discharges. Occasionally, instead of using liquid resistances, metallic resistances, oil-immersed, are employed.

It has been found that with the non-arcing arrester, using a series of non-arcing cylinders between line and ground, if these cylinders are all of the same size a higher voltage is impressed on those nearer the line. To overcome this difficulty in part the Alioth company uses larger cylinders in the first few sets nearest the line.

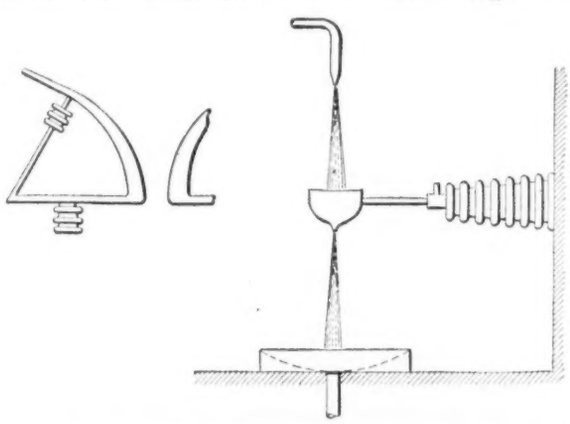


FIG. 3—BRACED HORN AS DEVELOPED BY THE ALIOTH COMPANY; FIG. 4—SIEMENS-SCHUCKERT WATER-JET ARRESTER AT TOR DI QUINTO

The Alioth company, as well as most of the other electrical manufacturers in Europe, frequently uses a water jet as a static discharger. This water jet, as shown in Fig. 2, consists of a jet of water squirted up from a grounded water pipe against a metallic plate connected to the line. The section of the jet and its height will depend on the voltage of the line, the purity of the water

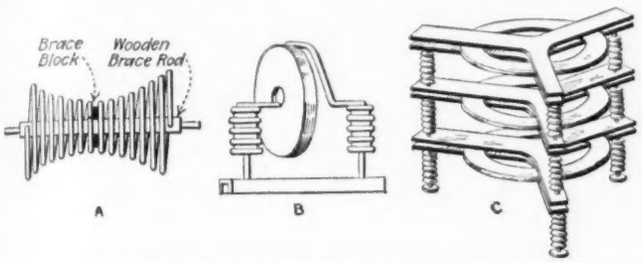


FIG. 5—TYPICAL EUROPEAN CHOKE COILS
(A) Braced hour-glass choke coil (A. E. G.). (B) Alioth choke coil. (C) Coils for Siemens multi-choke-coil arresters.

and other features. Experience seems to show that the resistance of the water jet should be such as to allow a constant passage of 0.1 amp. to 0.2 amp., as this is sufficient to protect the line against a dangerous increase in pressure. With ordinary water it has been found that for a pressure of 20,000 volts the section of the water jet should be about 150 sq. mm., and the height of the jet about 340 mm.

As indicated in Fig. 2, it is customary to place an ammeter in each circuit from the line to the plate of the water jet, and usually a disconnecting switch is furnished for cutting off the discharger. Occasionally a small disconnecting switch is provided for short-circuiting the ammeter.

For high-voltage service, where comparatively large horns are required, these are frequently braced in the manner shown in Fig. 3, which illustrates the type of horn used on an Alioth lightning arrester at Grenoble on 65,000-volt service.

At the Tor di Quinto substation near Rome the Siemens-

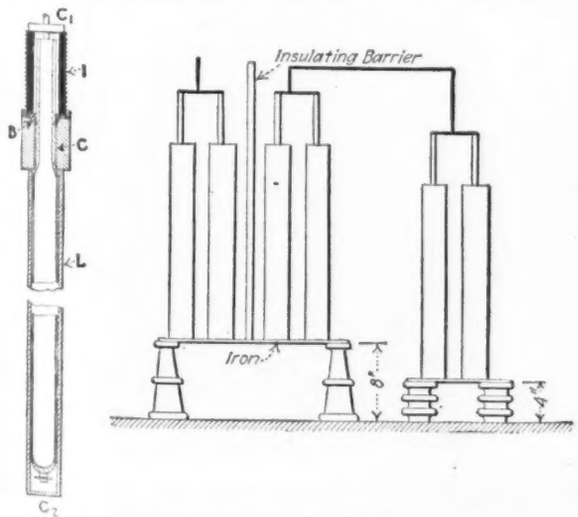


FIG. 6—MOSCICKI CONDENSER-TUBE ARRESTER

Schuckert company had installed on the 60,000-volt bus system a water-jet arrester arranged as shown in Fig. 4 to give a double path to ground.

Choke coils typical of European design are shown in Fig. 5. At Lavagnola the A. E. G. coils for the 70,000-volt circuits had two coils in series of round copper, diameter 8 in. to 4 in. (20 cm. to 10 cm.), about sixteen turns. At the center of the coil was a solid block of wood, the width of three turns, and a wooden rod about 2 in. (5 cm.) in diameter was axially affixed to this central block and to the end turns, which are clamped diagonally, as shown in Fig. 5A. Fig. 5B shows the type of choke coil that the Alioth company furnished in the 65,000-volt incoming lines at Grenoble. These coils had about eighteen turns, the over-all diameter being about 12 in. (25 cm.). The mechanical supports seemed weak. At the Tor di Quinto station on the 60,000-volt incoming lines the Siemens-Schuckert company provided each line with a set of flat choke coils as shown in Fig. 5C. Each incoming line has a set of these choke coils with shunted horn gaps which go to earth through a 1500-ohm resistance.

Condensers of the Moscicki type are used in many places in Europe to provide a path to ground for the static on the line. The essential feature of these condensers is that

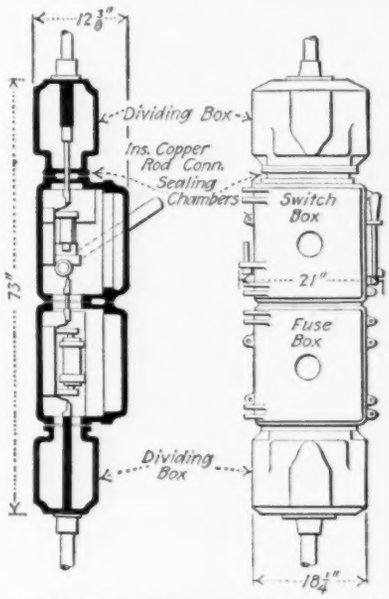


FIG. 7—BRITISH WESTINGHOUSE IRON-CLAD SWITCHBOARD UNIT

illustrated in Fig. 6. These condensers are made of glass tubes with a neck "C" of a thickness three or four times greater than the rest of the tube. The tube itself is covered inside and out with a silvering deposited chemically. This film of almost infinitesimal thickness is, in its turn, covered by a copper plating of a greater thickness to give it the necessary carrying capacity. The glass of the tube is approximately half a millimeter thick and can withstand approximately 67,000 volts on the lower part, but a lesser pressure near the top, which accounts for the necessity of thickening the neck of the tube.

The assembled tube is provided with an upper contact, *C-1*, connected to the interior armature of the condenser, and a lower contact, *C-2*, connected to the external armature. The neck of the tube is inclosed in a hollow insulator, **1**, to secure good insulation between the two plates of the condenser. The tube of glass is then inserted in a tube of brass or of tin plate, *L*, and to keep out water is provided with a conical rubber stopper, *B*. The porcelain insulator is provided with a bayonet socket, and the contact of the external plate of the condenser is made to the metal tube. The annular space between the glass tube and

the metal tube is filled with a non-freezing mixture of distilled water and glycerine.

Each of these condenser tubes is normally designed for a pressure of 10,000 volts to 15,000 volts, and they are tested to 27,000 and 40,000 volts. For pressures above 10,000 volts to 15,000 volts batteries of tubes are connected in series as shown in Fig. 6, which indicates the arrangement of the Moscicki tubes at Volturno. In this station for 60,000-volt service there are eight condensers in parallel, three in series.

Owing to the more extended experience in America for voltages beyond 100,000 it is very probable that European systems operating at such voltages will tend to follow the American practice and use electrolytic lightning arresters for outdoor service in such plants.

SWITCHBOARDS AND INSTRUMENTS

European switchboards are built in many styles, embodying panelboards, cabinets, crucible constructions, control desks, pedestals and posts, draw-out switchgear, truck panels, etc. Many European electrical manufacturers build practically all of these different types of boards, but

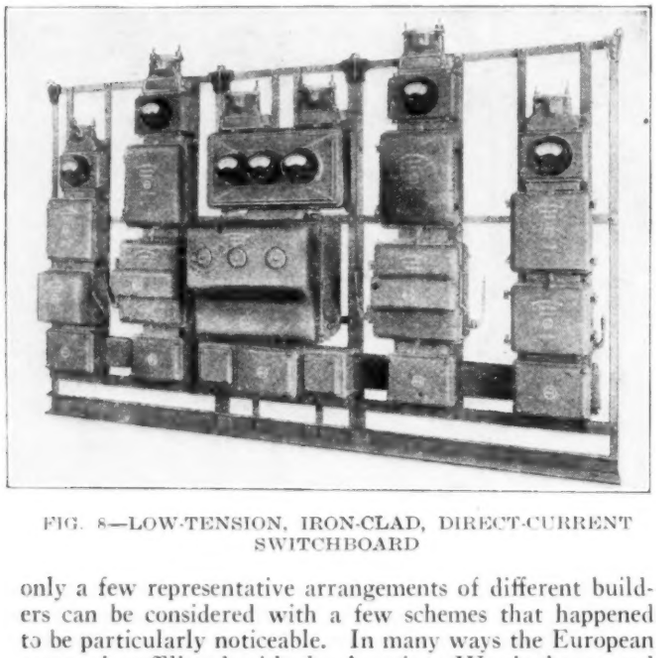


FIG. 8—LOW-TENSION, IRON-CLAD, DIRECT-CURRENT SWITCHBOARD

only a few representative arrangements of different builders can be considered with a few schemes that happened to be particularly noticeable. In many ways the European companies affiliated with the American Westinghouse and American General Electric follow the designs of their parent companies, but they usually modify such designs to meet European conditions.

An arrangement somewhat similar to the usual cubicle construction used by the British Westinghouse Company but employing knife switches and fuses is illustrated in Fig. 7, which shows a single panel switch and fuses with end bells for wall mounting. A three-conductor cable is brought in from above to an end bell or dividing box installed in a compound-filled cast-iron housing. Insulated copper-rod connections pass out through the end-bell box into the switch box, and the joints between the two boxes are sealed in with bitumen. In a like manner connections are taken from the switch out through the bottom of the switch box into the top of the fuse box. After passing through the fuses connections are taken to the dividing box or cable bell for the outgoing leads. The knife switch is operated by a handle on the outside, and it is impossible to open the door either of the switch box or the fuse box until the switch is moved to its open position.

Fig. 8 shows a portion of a low-tension iron-clad direct-current switchboard built by Mavor & Coulson for the control of two generators and three feeders. The various

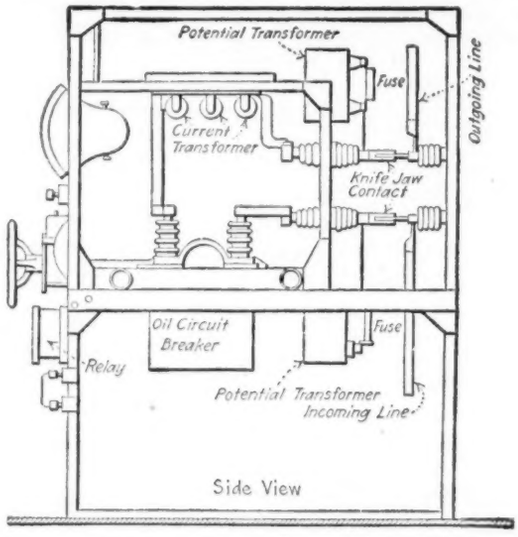


FIG. 9—TRUCK-TYPE PANEL AS DEVELOPED BY THE A. E. G.

switches, fuse holders, etc., are all contained in cast-iron boxes, while any cross-connections between the panels are carried in conduit. The whole equipment is assembled on a skeleton steel frame and provision made for the cables running to the generators and feeders. The generator rheostats are inclosed in cast-iron boxes, while the ammeters and voltmeters are mounted on the face of cast-iron boxes, connections being made to them from the rear.

A very popular type of switchboard arrangement in Europe for industrial plants is the wagon panel or truck-type board. All high-tension busbars and cable connections are carried on heavy porcelain insulators mounted in

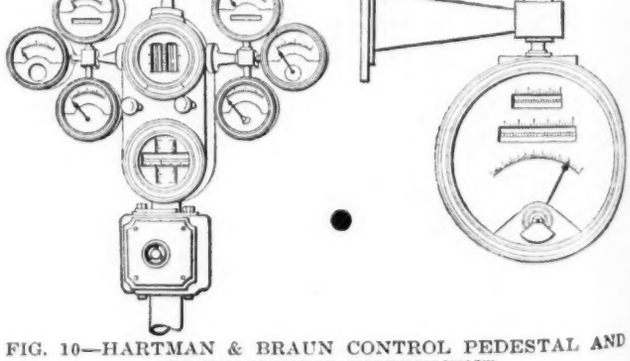


FIG. 10—HARTMAN & BRAUN CONTROL PEDESTAL AND SYNCHRONIZING INSTRUMENT

frame castings built up to form a complete cell structure. The framework is so designed that new panels can be added at any time, the complete structure being finished off by cover plates bolted to the ends of the bus chamber, except in cases where the incoming cables are connected directly to the busbars at this point.

The whole of the apparatus for each circuit equipment, including the oil circuit breaker, instruments and transformers, is mounted on a movable truck that can be withdrawn from the front of the board and wheeled away for inspection. It is a fairly simple matter to have a spare truck available so as to minimize the time that any circuit

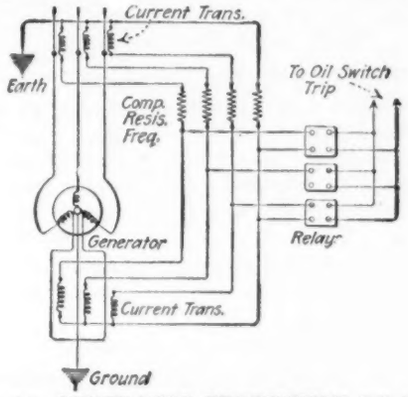


FIG. 11—GENERATOR PROTECTION BY THE MERZ-PRICE SYSTEM

will be out of commission in case of trouble to the switching equipment.

Fig. 9 shows a typical A. E. G. wagon panel for a plant of moderate capacity, and it is customary to place such panels in the walls of the generator room, having the instruments and operating devices in the generator room and the rest of the equipment in a separate room. A special truck is provided to take the oil circuit breaker and complete wagon panel when it is rolled out from the wall. The panel itself is of steel plate supported on a structural framework and carries a round-pattern synchronoscope, round-pattern synchronizing voltmeter, flush-mounted sector-type wattmeter, voltmeter and ammeter, overload relay, circuit breaker and similar devices.

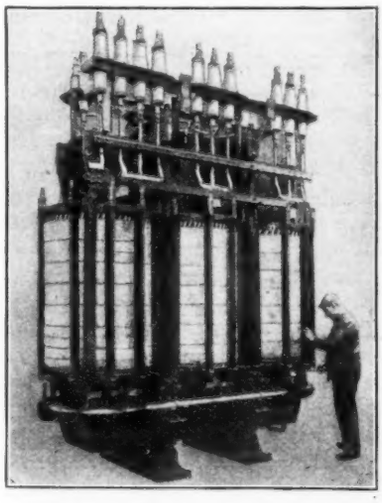


FIG. 12—ONE OF THE LARGEST TRANSFORMERS IN EUROPE
Brown-Boveri, three-phase, oil-immersed, 23,500-kva., 5000 volts to 25,500 volts

Fig. 10 shows a collection of Hartman & Braun instruments installed on a control pedestal. The lowest instrument on the vertical center line of the pedestal is a multicellular static voltmeter. The instrument directly above it is a duplex-scale vibrating-reed frequency meter used for the purpose of synchronizing. The other instruments, such as ammeters, voltmeters, wattmeters, etc., are of the same general appearance and design and are so built that the connections can be taken through the case at the bottom, the side, the top or the back, depending on how the instruments are to be mounted.

A Hartman & Braun synchronizing instrument is also shown, installed on a stationary bracket projecting from the switchboard, which bracket also contains two synchronizing lamps. The combination meter included a voltmeter and two vibrating-reed frequency-indicating devices.

The relays used in Europe are made of the solenoid type or induction design, depending on circumstances, and the European Westinghouse and European Thomson-Houston companies have lines of relays practically paralleling those of the American Westinghouse and American General Electric companies. The solenoid-operated relays are made either of the circuit-closing or circuit-opening type, and various

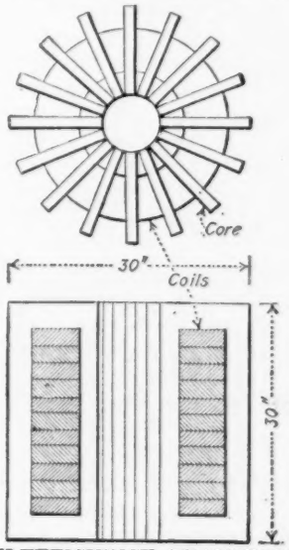


FIG. 13—HIGH-EFFICIENCY TRANSFORMER WITH CIRCULAR COILS

features of overload, reverse power, time limit, etc., are available both for alternating-current and direct-current circuits.

In England as well as in other European countries the Merz-Price system of balanced protection is frequently used. Fig. 11 shows the scheme adopted for generator protection using series transformers at each end of the winding, the neutral point in the case of star-wound machines being made so that the transformers are connected between the generator windings and this neutral point. A modification of this arrangement can be used to secure balanced protection in the case of transformers on the high-tension and low-tension circuit, and a similar arrangement can be used in connection with cables or similar circuits tying together two or more stations, provided that suitable connections are run between the relays in the different stations.

TYPICAL TRANSFORMER PRACTICE ABROAD

For power transformers European practice greatly favors the employment of the core-type design as the question of facility and speed of repairs and replacement of coils is given more prominence than is the case in America.

Until recently the question of thorough bracing for the

transformer coils was not a matter of such grave importance as in America as the amounts of power concentrated on high-voltage systems were usually rather moderate. During a series of visits to power plants in Italy and France, toward the end of 1917, in practically every station there was a core-type transformer out of commission being rewound and rebraced, evidently having been damaged by short-circuit stresses. Many of these transformers had been in service for considerable time and had doubtless been installed when the amount of power available on the systems was considerably less and when their bracing was probably sufficient for the short-circuit strains to be expected from a moderate-sized system.

A Large European Transformer

Fig. 12 shows one of the largest transformers in Europe, this being a 23,500-kva. 5,000/25,500 volt, 50-cycle, three-phase transformer built by the Brown-Boveri company. This is of the usual design with the high-tension winding star connected, the neutral of the star being brought out through the terminals at the extreme left-hand end. Tap leads in each phase are brought out through separate high-tension insulators.

The insulated tie rods holding the plates at the top and bottom of the coils are provided with compression springs so as to allow for a certain slight movement of the coils. Lock-nuts are used to insure against the tie rods becoming loose.

For the Adamello installation in Italy the 2700-kva. Brown-Boveri transformers, 10,000/60,000 volts, 42 cycles, were designed, suitable for operation at 72,000 volts, and had a guaranteed full-load efficiency of 98.7 per cent, a three-quarters load efficiency of 98.6 per cent and a half-load efficiency of 98.3 per cent. At 80 per cent power factor the efficiencies were 98.3, 98.2 and 97.8 respectively. The drop at full load, 100 per cent power factor, was 1.05; at 90 per cent power factor, 2.85; at 80 per cent power factor, 3.55; at 70 per cent power factor, 4. These transformers had a temperature rise at 45 amp., 72,000 volts, of 45 deg. C. above the cooling water and were guaranteed capable of operating without water for two hours with a 60-deg. temperature rise above the air at 25 deg. These transformers were designed to carry 10 per cent overload continuously, 25 per cent overload for one hour, 50 per cent overload for fifteen minutes. They had a no-load loss of 27 kw. at 60,000 volts and were tested for 90,000 volts.

English Transformer of High Efficiency

Among the smaller builders of transformers the Berry company in England has been very successful in producing high-efficiency units. Fig. 13 shows a 500-kva., 5500-volt transformer with the iron arranged radially and circular coils utilized for both the high-tension and low-tension windings.

In the electric plant of the Leeds Corporation in England there are eleven pairs of these 500-kva. Berry transformers tying together the two-phase and three-phase systems, 2000 volts and 6500 volts, as well as other transformers furnishing a 220-380 volt, three-phase, four-wire system. According to test on a 200-kva. size, the full-load efficiency was 99 per cent; three-quarters load efficiency, 99.02 per cent; half-load efficiency, 99 per cent. The test records, however, did not state how the measurements were taken or at what temperature the transformer was operating.

OIL VERSUS COAL AS FUEL FOR CENTRAL STATIONS*

Relative Prices Contrasted—Initial Cost of Installation—How the Operating Advantages of the Two Fuels Compare

BY C. H. DELANEY
Pacific Gas & Electric Company

ON THE Pacific Coast fuel oil is the only fuel available, except the small quantity of coal which is used chiefly for domestic purposes. However, where both kinds of fuel are avaiable in sufficient quantity the question as to whether it is advisable to use fuel oil in preference to coal may best be considered in the following order:

(1) The relative prices of the two fuels.

(2) The initial cost of installing the necessary handling and firing equipment.

(3) The relative operating advantages.

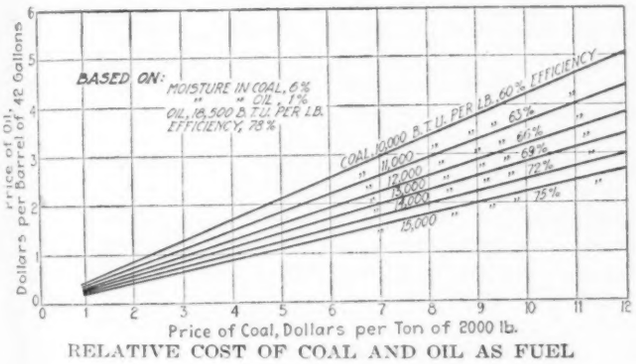
In the accompanying set of curves a comparison is shown of fuel oil with coal of heating values varying from 10,000 to 15,000 B.t.u. per pound (1140 calories to 1710 calories per kg.). The heating value of the oil is taken as 18,500 B.t.u. per pound (2100 calories), which is a fair average value for California oil, the variation from this value being small. The efficiency of 78 per cent for oil firing assumed in these calculations can readily be maintained in normal service provided that proper attention is paid to the furnace design and the regulation of the fires. In order to make this comparison fairly correct for the different grades of coal, an efficiency of 60 per cent has been assumed for coal having 10,000 B.t.u. and 75 per cent for coal having 15,000 B.t.u. per pound, with intermediate values for coals that lie between these extremes. As the heating value of coal is usually given on the basis of dry coal, and as coal when purchased invariably contains a considerable proportion of moisture, it has been assumed that the coils considered in this comparison contain 6 per cent moisture. In the case of fuel oil the water content does not usually exceed 1 per cent, and this value has been assumed in the comparison. It will be observed from the diagram that oil at $1.50 per barrel is equivalent in price to 14,000-B.t.u. (1600-calory) coal at $6 per short ton. Oil at $1.50 per barrel is also equivalent to 12,000-B.t.u. (1370-calory) coal at $4.60 per short ton.

An oil-fired plant is considerably cheaper to build than a coal-fired plant. The equipment required for oil firing consists of oil-storage tanks, oil pumps, oil heaters and oil burners. This equipment with the interconnecting piping takes the place of the coal-storage pile, coal elevators and conveyors, coal bunkers, stokers and ash-handling apparatus. The oil pumps and heaters are quite small as will be readily realized when it is considered that the quantity of oil handled is less than one-tenth the quantity of water fed to the boilers. Oil burners are also simple and inexpensive, so that the entire cost of equipment is much less than that of the equipment required for coal burning (about $2.50 per horsepower). Furthermore, smokestacks may be made small if a plant is to use oil exclusively, as the draft required is less and, owing to the small amount of excess air, the gas volume is also less than for coal firing. Moreover, the labor in the oil-fired plant

* Presented before Association of Edison Illuminating Companies.

is much less than in a coal-fired plant, and consequently the actual comparison for any particular plant will be somewhat more favorable to oil than is shown in the diagram.

Fuel oil is burned in a furnace similar to an ordinary hand-fired coal grate, except that the grates are covered over with firebrick with spaces between them, placed in such a position as to allow the air to enter directly under the flame at the points where it is most effective. In some cases the grates are omitted altogether and the firebrick is supported on pipes or I-beams. The oil on reaching the boiler room is heated to a temperature of approximately 180 deg. and is delivered to the burners at this temperature and a pressure of 40 lb. to 50 lb. (2.8 kg. to 3.5 kg. per sq. cm.). The oil is atomized in practically all power plants by steam. While compressed air may be used for atomizing, it is found that the quantity of steam used is so slight as to make the installation of an air compressor unprofitable. In normal operation it is customary to use about 3 or 4 per cent of the steam generated for atomizing, but by proper care in heating the oil and in the design of


BASED ON:
MOISTURE IN COAL, 6%
" " OIL, 1%
OIL, 18,500 B.T.U. PER LB.
EFFICIENCY, 78%
COAL, 10,000 B.T.U. PER LB. 60% EFFICIENCY
11,000 " " " 63% "
12,000 " " " 66% "
13,000 " " " 69% "
14,000 " " " 72% "
15,000 " " " 75% "
Dollars per Barrel of 42 Gallons
Price of Coal, Dollars per Ton of 2000 lb.

RELATIVE COST OF COAL AND OIL AS FUEL

the burners and furnace it is possible to reduce this to less than 1 per cent.

The two important types of burners are classified as (1) inside mixers and (2) outside mixers. In the former the steam and oil come into contact within the burner and the mixture is atomized in passing through the orifice of the burner nozzle. In the outside-mixing type the steam flows through a narrow slot or horizontal row of small holes in the burner nozzle; the oil flows through a similar slot or hole above the steam orifice and is picked up by the steam outside of the burner and atomized.

It is customary to use not more than four burners to fire one boiler, and frequently three burners for a boiler of the largest standard size up to 800 hp. The atomized oil is introduced into the furnace in the direction in which it increases in height. This increase in furnace volume in the direction of the flame insures free expansion, a thorough mixture of the oil with the air and the consequent complete combustion of the gases before they come in contact with the tube-heating surfaces. When the burner is introduced through the fire doors, shooting the flame back toward the rear of the furnace, it is known as a front-shot burner. It is termed a back-shot burner when it is placed at the bridge wall, the steam and oil pipes running through the ash pit to this point. In this case the burner is pointed toward the front and the flame shoots toward the front part of the furnace.

By careful arrangement of the air spaces between the bricks laid on the grates it is possible to obtain perfect combustion of fuel oil with not more than 15 per cent excess air, and it is due to the small amount of excess air required that the high efficiencies are obtained.

The predominating oil used on the Pacific Coast, known as Bakersfield oil, averages about 16 deg. Baume, which is equivalent to 336 lb. (152 kg.) of oil per 42-gal. (159-l.) barrel. The accompanying table shows the ultimate analysis of an average sample of this oil, the amount of air chemically required for perfect combustion, the amount of air actually supplied per pound of oil for different percentages of CO_2, and the amount in per cent that this quantity of air is in excess of chemical requirements.

One of the greatest advantages of the use of fuel oil is that it is possible to regulate the firing entirely automatically. The supply of oil to all burners, the supply of atomizing agents to all burners and the quantity of air required to burn this oil may be automatically controlled from a central point. A slight variation in the steam pressure on the boilers, due to any variation in the demand for steam, is the primary means of control for a steam regulator or governor which varies the quantity of oil fed to the burners and the quantity of air admitted to the furnace.

While the main advantage of the automatic device is that it insures the boiler operating at maximum efficiency at all times, it also has the advantage of causing considerable saving in labor. This advantage will be especially true in the case of small isolated plants where the firing is of poor quality and where the cost of labor is large in proportion to the quantity of fuel burned. It is in these small plants scattered throughout the country that the greatest benefit would de derived if it were possible to substitute fuel oil for coal.

For standby plants perhaps the greatest advantage in the use of oil as fuel is the rapidity with which a fire can be started. It takes only about thirty seconds to light a torch, place it in the furnace and turn on the atomizing steam and the oil, and as soon as this is done a full fire is obtained. While the efficiency obtained is not so high as it becomes after the brickwork gets hot, it is possible to raise steam very rapidly. It is not uncommon to have a boiler started up with cold water ready to cut in on the line thirty minutes after lighting the fire.

Another advantage which applies especially to stand-by plants is the fact that with oil there is no such thing as a banked fire, for when the steam is not needed the fires are simply put out. This entirely does away with the loss due to poor combustion of coal in a banked fire, which is often very considerable. In a stand-by plant where it is necessary to keep up steam on the boilers ready to pick

ANALYSIS OF SAMPLE OF BAKERSFIED OIL

Carbon, 85 per cent; hydrogen, 12; sulphur, 0.80; nitrogen, 0.20; oxygen, 1; moisture, 1; flash point, 239 deg.

Per Cent CO_2 by Volume as Shown by Analysis of Dry Chimney Gases	Pounds of Air per Pound of Oil	Per Cent of Air in Excess of Chemical Requirements
6	34.90	149
7	30.04	114
8	26.39	88
9	23.56	68
10	21.29	52
11	19.43	39
12	17.88	28
13	16.57	18
14	15.45	10
15	14.48	3
15.52	14.02	Chemical requirements

up the load at any moment the method usually employed is to fire up a boiler until the full steam pressure is reached, then to put out the fire and allow the pressure to drop 20 lb. or 30 lb., and then to relight the fire, bringing the steam up to the full pressure again. With this method it is possible to keep up steam by using only 1½ per cent of the quantity of oil required to operate the boiler at its full rated capacity.

It would seem that stand-by plants, though regularly burning coal, might be justified in installing fuel-oil burners, together with a storage tank and the necessary pumps, regulators, etc., to be used in case of emergency. The value of such insurance, however, would naturally dictate its advisability in each specific case.

Where oil and coal are burned together care must be taken to prevent too great a concentration of heat on any one portion of the boiler. In an oil-fired boiler care must also be taken to avoid any accumulation of gas inside the setting which might lead to explosions resulting in considerable damage.

Vision in Power Development*

Test of War Proved the Strong Position of the Central Station in Power Production—Government Aid Needed to Realize Full Benefits of Centralized Systems

BY FREDERICK DARLINGTON
Consulting Engineer Westinghouse Electric & Manufacturing Company

WHEN the war came with its imperative need for greatly increased power service, for conservation of resources in labor and material, and for all things which go toward productive efficiency and the maintenance of social welfare, the electric power systems of the country had progressed far toward centralization of power manufacture.

The magnitude of central electric systems was increasing rapidly, investors were contributing the required capital, and central systems were doing something like one-half of the work that economically and properly belonged to them, while the other half of their work was being done by isolated plants.

What the war has brought out is direct confirmation of the principles enunciated by leaders in central-station development, and no doubt remains of the fundamental soundness of centralizing power manufacture.

Power Survey

The War Industries Board on behalf of the government asked to be advised concerning power resources for war work in certain specific sections, notably in and around Pittsburgh, Philadelphia and Chester, Niagara Falls and Buffalo, New England, the Southern States, etc. I aided in some of these inquiries and afterward was drawn into the position of chief of the Power Section of the War Industries Board, reporting to Chairman B. M. Baruch of that board.

Army engineers in the field, reporting on power requirements and resources in various cities and sections where war work was being done, soon demonstrated that expanding centralized electric power systems with large generating plants was the only effective way of securing increased power. Some one came to me with the statement that the manufacturing companies had more than a million kilowatts of electrical machinery in turbo-generating units of 10,000 kw. or greater in process of manufacture or on order.

At first that sounded reassuring, but when the government point of view developed it was obvious that the economic need of the nation was not for a million kilowatts of additional central-station generating capacity but for something like ten times that much, and that if the war continued there would be an emergency need for something like two million kilowatts of new central-station capacity.

Interconnected Generating Systems

It came down to something like this: Central electric development has reached a stage where the best and most economical method of supplying power for practically all purposes is by large interconnected central electric systems covering interstate areas which constitute natural power service districts. Generally these natural power districts include much larger areas than are to-day served by single systems and call, therefore, for interconnection and unification of existing systems and joint operation of their facilities for maximum reliability and economy. The natural boundaries to these power districts are independent of lines of private ownership or of state lines, and the most effective way of supplying power is by developing the best and most reliable natural resources for power generation in each district.

The natural grouping of some of the important power districts, as determined by men on government work during the war, is as follows:

A New England power district, including all of the industrial and thickly populated sections of New England with central-station generation by steam and water.

An Eastern Pennsylvania-New Jersey district, including the hard-coal sections of Pennsylvania, and Philadelphia and Chester, together with the industrial portions of New Jersey.

A Western Pennsylvania-Eastern Ohio district, embracing western Pennsylvania and a large portion of central and eastern Ohio.

A Southern States power district, including all of the principal industrial sections of five Southern States, Alabama, Georgia, Tennessee and North and South Carolina.

Power development in New York State should be considered in conjunction with New England and New Jersey and Pennsylvania and Ohio, attention being given to the Niagara River and St. Lawrence River resources. On these two rivers, partly on the national boundary and partly within Canada, there are water-power resources for the development of several million horsepower (without

* An abstract of a paper read before the Association of Edison Illuminating Companies, New London, Conn., Sept. 15 to 18.

destruction of the scenic beauty of Niagara Falls), which should be developed under an international agreement and a portion of the power distributed over an interconnected system centralized in northern New York State and adjacent Canadian territory with tie lines to the above-described New England power district, the Eastern Pennsylvania-New Jersey district and the Western Pennsylvania-Eastern Ohio district.

At first thought this appears to be an ambitious program, but intensive need and urgent study during the war clearly pointed to this plan being fundamentally sound, both economically and from the engineering view, and especially so if the herein recommended unified systems are built up for the New England, the Eastern Pennsylvania-New Jersey and the Western Pennsylvania-Eastern Ohio power districts, so that these districts would be equipped each within itself for the distribution of large blocks of base power from Niagara and St. Lawrence River sources.

When the demands of war forced our nation to seek a high rate of production combined with the highest attainable conservation of labor and other resources, inefficiency became so intolerable that the government point of view drew a sharp line between manufacture of power by central-station electric systems and manufacture by isolated plants.

Half or more than half of the power consumed in each of the big power districts above described (considerably more than half in some districts) was manufactured by isolated or individual plants located in mills, factories, private buildings or other establishments. These isolated plants on the average consume two or three or more times as much labor and fuel and other materials as central-station systems for the same service. This condition was very serious when our nation was straining every nerve to win the war by conserving coal and labor and lightening transportation, etc., and the Fuel Administration joined strongly with the other governmental departments in condemning isolated-plant operation and demanding the maximum possible use of the largest and most efficient central stations.

EASTERN POWER DISTRICTS

In the New England district there is an annual production of approximately 6,500,000,000 kw.-hr. of which about 2,500,000,000 kw.-hr. is produced by steam and hydroelectric central stations at good efficiency. Reliability, economy and conservation from a national point of view indicate that the existing New England systems should be better interconnected and unified in operation, and central generation should be increased 2,500,000,000 kw.-hr. to 3,000,000,000 kw.-hr. annually, of which 1,000,000,000 kw.-hr. should be by new hydroelectric power.

In the Eastern Pennsylvania-New Jersey district the present power production is about 6,000,000,000 kw.-hr. annually, of which about 2,000,000,000 kw.-hr. is produced by central systems and the rest by isolated plants. It is indicated that for increased reliability and economy the central systems of this district should be better interconnected and additional generating plants constructed for the manufacture of approximately 2,000,000,000 kw.-hr. annually. In this section there are undeveloped water-power resources for more than that amount.

In the Western Pennsylvania-Eastern Ohio district there is an annual production by the central systems of approximately 2,000,000,000 kw.-hr. annually. These systems should be better interconnected and their capacity approximately doubled by the construction of additional new steam and hydroelectric plants for about 2,333,000,000 kw.-hr. annual production.

In the Southern States power district there is an annual production of about 1,500,000,000 kw.-hr. by central systems, which should be better interconnected and their capacity increased for an added production of about 1,000,000,000 kw.-hr. per year, mostly hydroelectric power.

UNIFIED POWER SUPPLY

No great new discovery or development is necessary to realize the government vision of the power business, and this very fact makes it more striking. For instance, for all of the things above described as practicable and desirable to attain no new or untried engineering is essential or is even desirable, except perhaps for the suggested Niagara River-St. Lawrence River development. For all of the other objects the hydroelectric and steam turbines already developed are ample and reliable.

Transmission-line voltages of 110,000 or 132,000 are sufficient and standard, and all of the matters of economy for successfully carrying out the undertakings are well understood. It fact, nothing is indicated by the government vision that is not easily within the field of practical development and private undertaking. This vision is already far advanced toward realization, and it simply remains to get better co-ordination and interconnection and to extend central-station power generation to increase reliability and economy.

The government vision of unified power supply, as I have tried to present it, does not contemplate a radical departure from present latest practice in regard to the location of generating plants, or the transmission of electric power by wire versus the hauling of fuel by rail, etc., which has been prominently advocated; and it seems that in the present state of the art we should be cautious not to be carried away by the idea of super-power plants located at coal mines, effecting extensive economies by coking coals, recovering by-products and transmitting electricity as against hauling fuel. Very alluring figures have been made and published on this subject, but so far the advantages of combining coking processes with electric power production have not been demonstrated by extensive development, and the theories on this subject are not proved.

Our laws, both national and state, need co-ordination with government vision, which shows clearly the waste of isolated-plant operation and undeveloped water powers and the lack of sufficient interconnection and co-ordination in operating central-station systems; but these are only what might be called the technical and physical requirements for an adequate supply of power. A broader vision points out restrictions to a reliable and efficient power supply growing out of conditions directly or indirectly imposed by government authority.

It appears from results that the power companies have been optimistic and have made highly creditable progress toward centralization and unification of power supply. I have already spoken of the 1,000,000 kw. aggregate of large units in electric generating machinery that could be used only for central systems which was on order for the power companies when the war commenced. This shows how the work was going ahead.

To comprehend the true situation the vision should be extended beyond the technical and physical problems to the financial, political and social conditions affecting power

developments. These are conditions that are controlled or directed by the government which are not nearly so favorable as they should be, and the government experience during the war accentuates this view. The construction of central power systems to be economically successful should be carried out with money bearing a low rate of interest. By the nature of the business electric power securities should be high-class, next in security to government bonds and on a par with the best investments in other lines.

This condition is not realized in the majority of instances chiefly because of the uncertainty regarding the earnings that are permitted to power companies by state commissions, municipalities and other regulatory bodies which seek to restrict capital to a low return. This in itself is right except that they so frequently overstep the mark and force an actual loss to investors in electric power undertakings, even when these undertakings are sound and advisable from an economic and social point of view.

The public has a right to expect and will demand adequate power for all industrial and social needs at the cost of production by central systems, including a fair return, but it defeats its own ends and subverts its best interest if it does not allow sufficient return to cover obsolescence and depreciation to insure preservation of invested capital.

Conservation of Resources

From a national point of view, as affecting the general industrial efficiency of our manufacturing and power-consuming districts, it is relatively unimportant whether the cost of power is one mill or two mills per unit more or less than some established rate, whereas it is of vital importance for conservation of resources, for economy of production and for general industrial efficiency that the bulk of the power used should be made by central systems as against isolated plants. Therefore let us try to get our lawmakers and public executives, national, state and municipal, to take the government point of view; in other words, to think in terms of the war, which are also terms of peace from a government standpoint, and uniformly and rationally to encourage central power development, provide for a just return to capital in electric power business and grant monopolies under regulations that will foster co-ordination and interstate operations.

It will not be many years before the supply of electricity for railroad motive power wherever railroad transportation is heavy will be the business of power companies, and the larger central power systems are when this time comes the better they can serve these railroads.

The aggregte increased production recommended above for prompt development by central stations in the four groups amounts to an increased manufacture of something like 8,000,000,000 kw.-hr. annually, much of which power would go to replace isolated-plant production. This would mean a saving of 10,000,000 tons to 15,000,000 tons of coal per year and a corresponding saving in labor and transportation.

The Law's Shortcomings

The fundamental ground for criticism in this matter rests not with the power companies but with our lawmakers and regulatory bodies. The water-power laws, the rulings of our commissions and the anti-trust laws combine to delay central-system power development, so that these millions of tons of coal and the corresponding labor for mining, transportation, etc., which we could conserve by an adequate investment of capital in centralized power systems are wasted in spite of enterprise and effort by the power companies and chiefly because our state and national governments fail to adopt a broad policy for conservation, reliability and efficiency. This, then, is the conclusion of governmental experience calling for a national vision.

What shall we do about it? Clearly it is not a case for government ownership, national, state or municipal. Fortunately for the power business, our nation is having an object lesson in government control of other industries which it is to be hoped will satisfy the public before government ownership of power companies is undertaken, or at least until some governmental organization is worked out of demonstrated efficiency for the job, which is far from being realized to-day.

CENTRAL ELECTRIC UTILITIES ARE ON A SECURE FOUNDATION

Committee of Investment Bankers' Association Says Events of Last Few Years Show that Electric Utilities Are Ideal Investments

At the recent meeting of the Investment Bankers' Association of America a report was presented by O. B. Willcox, vice-president of Bonbright & Company, Inc., of New York, as chairman of the committee on public service securities which pointed out the favorable position of electric utilities.

"The term 'public utilities,'" said Mr. Willcox, "has been generally used in recent years to describe electric industries, both traction and power and light companies. The events of the past few years show that the classification is too general and must be subdivided, and that when we examine public utilities we must approach those generating and transmitting electricity as a separate industry, free from both the history and the present difficulties of some other public utilities and possessing inherent qualities of their own, making for ideal investment situations. It should not be difficult to educate the public to renewed and increasing confidence in an industry which proved itself, even in the crisis of the war, so stable, resourceful, resilient and productive and which offers convincing promise for safe and remunerative employment of enormous additional capital."

Mr. Willcox declared that the power companies, excepting relatively few cases, particularly those of small companies whose output was used chiefly for lighting, not only escaped disaster during the war but generally justified the pre-war judgment of the investor that in point of steadiness of earning power and consistency of growth no business rests upon a more secure foundation than the electric generating and distributing industry.

"It is obvious," the committee says, "that new uses for electric energy have multiplied beyond expectation and that the increased efficiency through capable, inventive and progressive management and the decreasing costs of large production by plants of increasing size will compel the substitution of electricity for other forms of energy and its application to innumerable uses now only dreamed of. The billions of dollars already invested in electrical plants must be largely augmented, with resulting multiplication of the productive power of the country through the application of electrically driven mechanical devices to supplement the labor of the hands of men."

Electric Service at Naumkeag Cotton Mills

Methods of Inspecting and Maintaining an Installation of 3247 Motors—Features of Typical Drives Which Facilitate High Production Efficiency—A High-Quality Rather than a Low-Priced Installation the Object Sought

WHAT is understood to be the largest assembly of electric motors under one roof in any industrial plant in the world is operated by the Naumkeag Steam Cotton Company of Salem, Mass. The entire mill plant contains no less than 3247 motors, and of these 2920 are in a single room. This famous installation was described from the standpoint of equipment selection, layout and installation of apparatus by David Elwell in the ELECTRICAL WORLD of March 31, 1917, page 596. Brought into being by the burning of the mills in the great Salem fire of 1914, the new installation is soon to complete five years of service. The success of the electric drive is evidenced by the fact that in this period only four motors in the weave shed have had to be repaired and these repairs were very slight. The machinery in the spinning mill averages 96 per cent and that in the weave shed 97.5 per cent production, and the electrical maintenance and repair organization in this great establishment is one of the smallest in proportion to the connected load known in the industries of New England. The entire electrical supply since the opening of the new mills has been furnished by the Salem Electric Lighting Company.

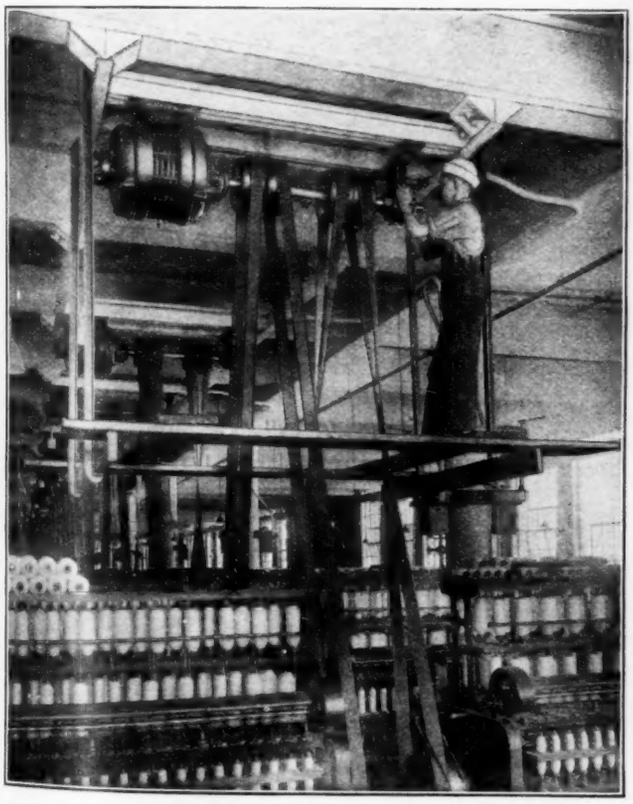


FIG. 1—FOUR-FRAME DRIVE IN SPINNING MILL WITH KNOCK-DOWN FRAME FOR REPAIR WORK OVERHEAD

The Naumkeag company manufactures cotton sheeting and pillow cases, about 1600 employees being on the payroll at present. The plant has a total floor area of about 1,000,000 sq. ft. (92,000 sq. m.). Its daily energy consumption is approximately 36,200 kw.-hr., and its total connected load in motors aggregates 6913 hp. Lighting is provided by 3500 lamps, ranging in size from 40 watts to 150 watts. Four 1250-kva. transformers installed in a semi-inclosed brick and steel shelter with concrete roof outside the spinning mill reduce the pressure of the central-station supply service from 2300 volts to 550 volts for the storehouse and spinning mill. In the weave shed 220-volt motors are used, these being served through local transformer banks supplied at 2300 volts. Details of the wiring installation were fully given in the article above mentioned.

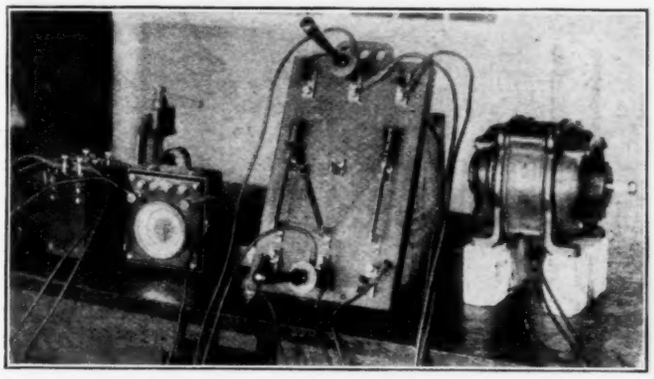


FIG 2—TEST BOARD PERMITTING INSERTION OF INSTRUMENTS IN MOTOR CIRCUIT WITHOUT INTERRUPTING SERVICE

The present motor installation is given in the accompanying table:

Size, Hp.	No. in Service	Total Hp.	Size, Hp.	No. in Service	Total Hp.
1-6	1	1·6	10	39	390
1-4	2	1·2	15	68	1020
1-2	1109	554½	20	4	80
3-4	1811	1358¼	25	71	1775
1	3	3	35	1	35
2	3	6	50	5	250
3	3	9	75	1	75
5	87	435	100	4	400
7½	28	210	150	1	150
Total				3241	6751
Including elevators and two small motor generator sets				3247	6913

All the motors in the weave shed are General Electric three-phase induction type, with cast-aluminum rotors. They are controlled by 220-volt snap switches mounted on pedestals near the looms, and the feeds from the switches to the motors are run in armored flexible conduit. Fuse boxes are united structurally with the switch containers. The motors drive the looms through friction bands and gearing in order to reduce the necessary starting torque as outlined in the former article. In the spin-

ning mill Westinghouse motors predominate in numbers. The weave shed has an area of 308,000 sq. ft. (28,336 sq. m.), and the motors are either of ½-hp. or ¾-hp. rating, according to the size of the loom. In the spinning mill the four-frame drive has been standardized.

The inspection and maintenance of the entire motor installation is handled by a staff of four maintainers, reporting to a chief electrician, who in turn reports to the

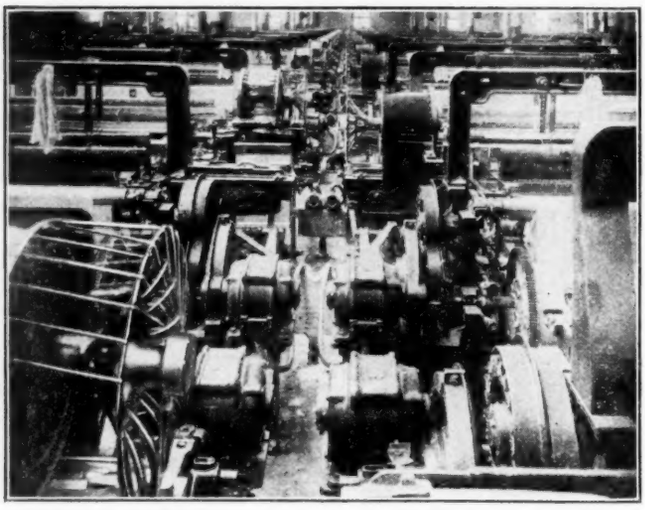


FIG. 3—INDIVIDUAL DRIVE FOR LOOMS; SNAP SWITCHES AND FUSE BOXES ON PEDESTAL CONVENIENT TO OPERATOR

superintendent of motive power. The last-named official reports to the mill agent. The mechanical condition of the shafting and bearings in the spinning mill is looked after by an oiler who devotes his entire time to this work. The oiler reports to the superintendent of the spinning mill, but in case he discovers abnormal conditions in the motor installation he reports it immediately to the electrical department. The extreme simplicity of this organization is evident from the accompanying diagram.

The headquarters of the electrical department are in the basement of the weave shed, and except in emergencies the chief electrician is stationed here in constant telephone communication with the various sections of the plant. The maintainers report here when not on repair or inspection work. This centralization of authority saves valuable time when any interruption occurs and enables the course of each job, whether one of fuse replacing or otherwise, to be followed from headquarters with a view toward the immediate return of the maintainer and his readiness for service on the next job reported. The stock of spare parts required for the power and lighting installation is kept here, together with testing instruments and records. The stock room and electrician's office occupy a space only 24 ft. by 25 ft. (7.2 m. by 7.5 m.) in floor dimensions, and the bin space required for the storage of spare parts, fuses, etc., for motors, fuses, oil-switch and lamp circuits is 10 ft. (3 m.) long, 6 ft. (1.8 m.) high and 76 in. (1.9 m.) wide, or half of the bin shown in an accompanying illustration. The stock bin contains about 100 compartments.

The proximity of the Naumkeag company's mill to the local factory of the General Electric Company at West Lynn, Mass., and to the stock facilities of the Westinghouse company in Boston—only about a half-hour distant in the latter case on a one-way run—reduces the amount of spare material necessary; but the absence of serious interruptions in the motor service during the entire history of the new mill is a still more important factor in this. The spare material carried includes:

Six spare loom motors, ½ hp.
Six spare loom motors, ¾ hp.
One spare motor of each type for spinning mill.
One spare armature for 110-volt direct-current knot-tying motor drives.
Twelve single-loom motor cut-outs.
Six double-loom motor cut-outs.
Six switches and covers for loom motors (three-pole snap type, G. E.).
Six gross machine screws (6-32 to 14-20).
Two spare bearings for each type and size motor in plant.
Three no-voltage oil-switch coils for General Electric motors.
Twenty-four no-voltage oil-switch coils for Westinghouse motors.
Spare parts to outfit complete four Westinghouse oil switches (about 300 Westinghouse oil switches are in service, type H).
Spare parts to fit out three General Electric switches.
Three extra sets of shafting bearings for each size shaft.
Spare fuses* in stock, 250-volt:

Amp.	No.	Amp.	No.
5	100	70	100
10	100	90	100
15	50	125	20
20	25	150	25
25	25	200	12
30	50	250	13
35	10	400	6
50	20	550	6
60	20	600	12
65	20		

600-volt fuses:

Amp.	No.	Amp.	No.
30	20	80	25
35	20	90	25
60	12		

2500-volt fuses stocked:

Amp.	No.	Amp.	No.
10	12	20	12

About $10 worth of spare conduit fittings for power work are carried.

The standard fusing of the weave-shed motors is 5 amp. for ½-hp. and 10 amp. for ¾-hp. motors. Experience shows that the 2.5-amp. size is too small for continuous

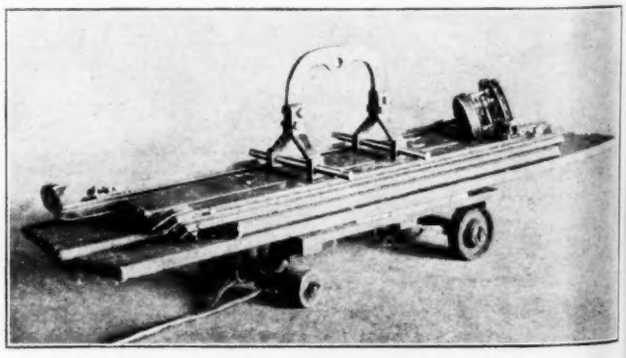


FIG. 4—KNOCKDOWN FRAME FOR HANDLING OVERHEAD MOTORS

service under the local production conditions with 5-hp. motors. No fuses are employed on the individual motor circuits in the spinning mill, overload-release oil switches being used instead. In the weave shed the looms range in size from 110 in. (275 cm.) to 40 in. (100 cm.), pillow-case size. The main fuses for the branch motor circuits are of 70-amp. or 90-amp. rating, depending upon the motor groupings on each circuit. Normally thirty-

*These fuses cover power circuits, weave shed, and fuses listed below cover circuits in spinning mill.

two motors are supplied from a single-branch circuit. The ½-hp. motors run at 1800 r.p.m. and the ¾-hp. motors at 1200 r.p.m.

The loss of fuses in these mills is unusually low. The record of fuse "blow-outs" in total of each size per week from the week ended May 31, 1919, to the week ended Aug. 30, 1919, inclusive, follows:

Week Ended	No.	Amp.	No.	Amp.	No.	Amp.	No.	Amp.	No.	Amp.
May 31	3	10	2	5	..	..	..	..	..	..
Jun. 7	10	10	3	5	..	..	..	..	..	..
Jun. 14	2	10	..	..	..	..	..	..	..	..
Jun. 21	1	10	9	5	..	..	..	..	..	..
Jun. 28	6	10	3	5	..	..	..	..	..	..
July 5	..	..	..	..	..	..	..	..	..	..
July 12	..	..	9	5	..	..	..	..	..	..
July 19	..	..	3	5	1	400	5	70	3	90
July 26	9	10	1	5	..	..	..	..	..	..
Aug. 2	7	10	3	5	..	..	..	..	..	..
Aug. 9	7	10	..	..	..	..	..	..	..	..
Aug. 16	10	10	..	..	..	..	..	..	2	90
Aug. 23	17	10	..	..	..	..	2	70	3	90
Aug. 30	28	10	3	5	..	..	..	..	..	..
Total for fourteen weeks	100	10	36	5	1	400	7	70	8	90

Note.—New looms being installed and tested in August were responsible for the blowing of twenty-five 10-amp. fuses.

The motor installation was planned with unusual care and high-quality service rather than a low-priced installation was sought. No better example could be cited of

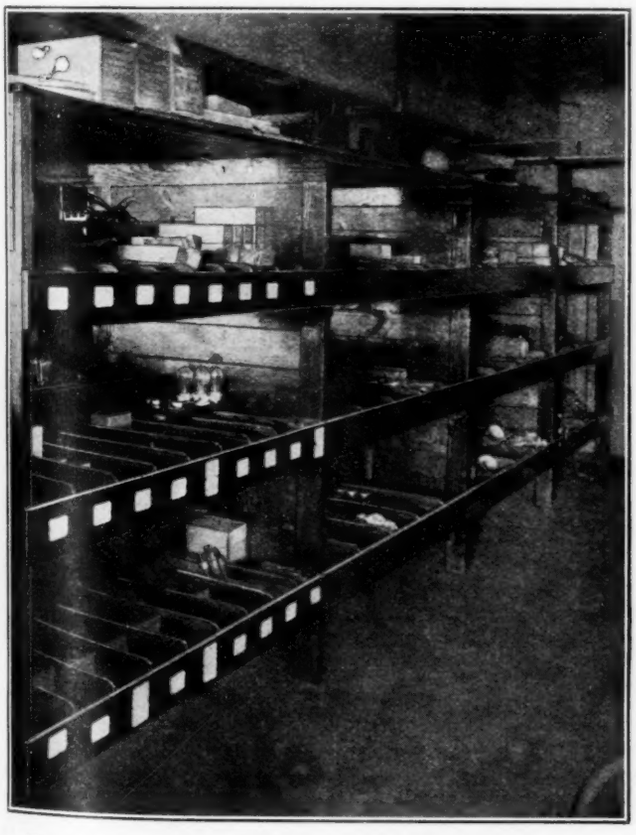


FIG. 5—STOCK BINS FOR ELECTRICAL SUPPLIES IN PLANT USING OVER 3000 MOTORS

the value of adopting motors determined by engineering requirements, putting first cost in a secondary place. In the weave shed probably not more than one motor has been opened in the past four years. As the bearings wear further this will become necessary in order to study the air-gap clearances. Some experimental installations have been made in the spinning mill, but in the weave shed the cost of motor repairs has been insignificant.

MOTOR INSPECTION PRACTICES

No regular printed or typewritten instructions are followed in motor inspection at the Naumkeag plant, but it is planned to oil the weave-shed motor bearings every

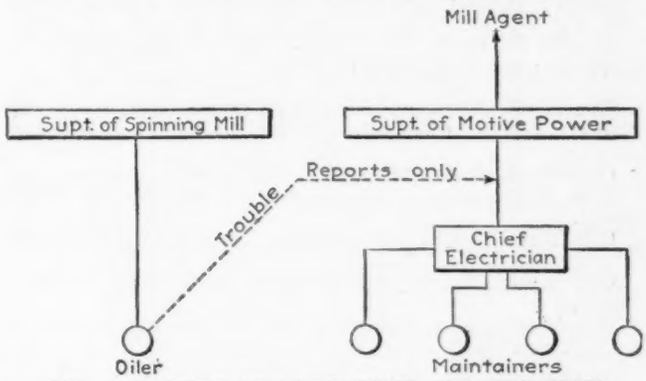


FIG. 6—NATURE OF ELECTRICAL ORGANIZATION

three months and to change the wicking once a year. The wicking is washed, pressed and returned to service. All drip oil which can be reclaimed is filtered and used again. The loom motors are of the totally inclosed type and cannot be blown out by compressed air, but the other motors are air-cleaned once in twenty-eight days. Humboldt babbitt metal is used in the motor bearings, and "Economy" cup grease is used. The oil is changed every six months in all motor bearings. In inspecting loom motors an examination is always made of the nuts on the end of the motor shaft to see if the pinion is tight on its taper, and the mesh of the gears is also observed.

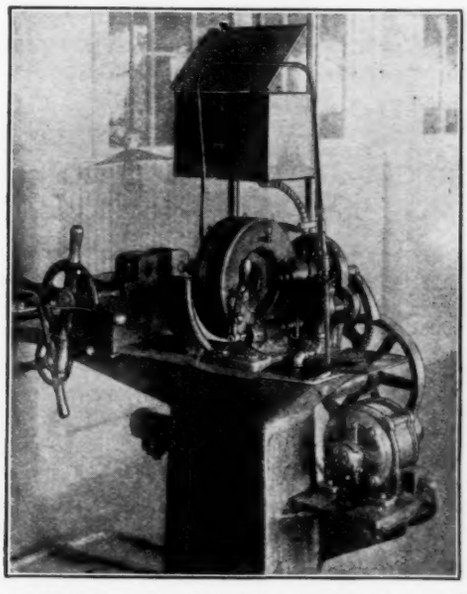


FIG. 7—REVERSING SWITCH FOR THIS PIPE CUTTING AND THREADING MACHINE IN BOX OVER MACHINE

Ring-oiling bearings are used throughout the spinning mill.

For bearing oil the lubricant is a straight Pennsylvania

Franklin stock, with red engine oil and tallow (acidless) in its make-up. This is also used in the air-compressor cylinder lubrication. Bearings in weave-shed motors are packed only on one side. The oil used does not foam, creep or harden and shows a high cold test. It is purchased locally. In cleaning motors in the spinning mill 30 lb. (2.1 kg.) of air pressure is used, besides a brush. A feeler gage has been found convenient for testing air gaps.

TESTING INSTRUMENTS IN ELECTRICAL DEPARTMENT

In the electrical department the following testing instruments are maintained:

One Westinghouse portable current transformer (0-250 amp. primary, 5-amp. secondary, split for 125 amp. and 250 amp. service).
One Westinghouse ammeter (125-250 amp.).
One Westinghouse portable current transformer (600-5 amp.).
One Westinghouse portable ammeter (5-amp. and 10-amp. scales).
One Westinghouse portable current transformer (10 volt-amp.).
One Westinghouse voltmeter, alternating current (300-volt and 750-volt scales).

FIG. 8—BUZZ PLANER SWITCH CAN BE TRIPPED QUICKLY FROM PLANER BY PULLING ROPE

Three principal oil-switch troubles have been found: Running single-phase, due to broken lead or contact, and detected by listening to hum of plunger in coil; wearing off of trigger point, now largely eliminated by the use of hard-steel stampings, and dash-pot friction. The average time required to restore service after receiving a trouble report from an oil-switch or spinning-mill motor seldom exceeds ten minutes.

Examples of the adaptation of quick-opening switch devices installed on some of the individually driven tools of the carpenter and machine shop of these mills are illustrated in the accompanying photographs.

E. A. Oliver is chief electrician and F. P. Cook superintendent of motive power of the Naumkeag mills.

PROCEDURE IN FORMULATION OF INDUSTRIAL SAFETY CODES

Dr. Stratton Issues Report on Results of Letter Ballot—Another Conference Will Be Held in Washington, Probably on Dec. 5

A report has been issued by Dr. S. W. Stratton, director of the Bureau of Standards, Washington, regarding the letter ballot on the question of procedure in the formulation of industrial safety codes, taken in accordance with the vote of the conference on this subject held in Washington on Jan. 15, 1919.

In the balloting the two plans submitted were those prepared by the committee appointed at the conference, consisting of C. A. Adams, H. W. Forster and E. B. Rosa. Ballots were sent to a designated list of federal bureaus, state commissions, municipal departments, technical associations, manufacturers' associations, utility associations, associations of government representatives, associations of insurance interests, safety and labor organizations.

Plan A consisted of the preparation of safety codes under the leadership of the Bureau of Standards with the co-operative effort of all interested organizations and under the general supervision of a large and representative conference committee.

Plan B consisted in the preparation of the safety codes and other standards by appropriate sponsor bodies, but under the auspices and procedure of the American Engineering Standards Committee as enlarged under a revised constitution. Since then the American Engineering Standards Committee has approved a revised constitution and has submitted it to the five parent engineering societies and the three government department members for ratification as provided in the old constitution.

The result of this ballot is as follows, the voting being by organizations rather than by individual delegates: For Plan A twenty-five votes were cast, for Plan B sixty votes. Of those voting for Plan A less than one-half indicated a likelihood of joining the Standards Committee in case its reorganization is completed. Of those voting for Plan B three-fourths looked forward to joining the committee. In other words, approximately 70 per cent of the ballots cast favor Plan B and about 66 per cent of the organizations voting would expect to join the enlarged and reorganized Standards Committee.

Dr. Stratton observes that the governmental bodies give a slight majority in favor of Plan B, that the engineering, utility and manufacturers' associations give a large majority on the same side, and that the insurance organizations are unanimously in favor of this plan. The two labor organizations voting favored Plan A. Most of the safety organizations favored Plan B. It is consequently evident that Plan B will secure the most general support and should be followed if the necessary conditions are fulfilled.

To consider this matter further and in order to make progress in the co-operative work necessary to formulate industrial safety codes, the Bureau of Standards is calling another conference to be held in Washington probably on Dec. 5, 1919. It is intended at that time to consider the procedure which should be followed in further work on safety codes and the co-operation that can be secured among the engineering societies, government departments and other agencies that are actively concerned with safety work.

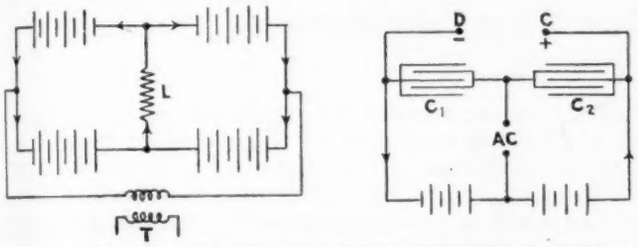
WAVE FORM OBTAINED FROM THE ALUMINUM RECTIFIER

Pulsating Current and Voltage from Aluminum Rectifiers Smoothed Out by Inductance in Series and Condensers Across Load

BY N. H. WILLIAMS AND J. M. CORK
University of Michigan, Ann Arbor

IN THE large volume of publications that have appeared concerning the aluminum rectifier two items of considerable interest have received very little attention. One is the production of voltages higher than those usually employed and the other is concerned with the wave forms that may be produced.

A single cell or element to be used as a rectifier consists



FIGS. 1 AND 2—CIRCUIT ARRANGEMENTS FOR ALUMINUM RECTIFIER AND LOADS

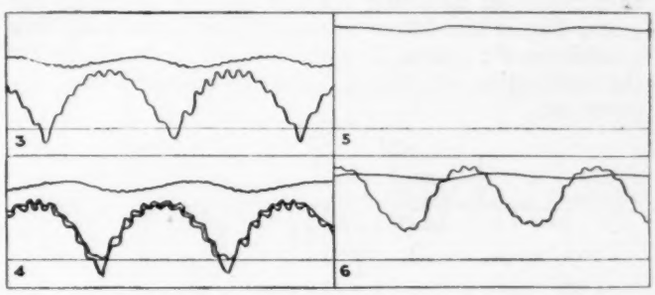
of an aluminum plate and a plate of some other conducting material, such as lead or carbon immersed in some salt solution. When such a cell is put into an electric circuit flowing from aluminum to lead, the electrolytic action gradually builds up a film of oxide or hydroxide of aluminum, and the current diminishes and ultimately reaches values approaching zero. For currents in the opposite direction the cell has comparatively low resistance. If the applied voltage is raised, the current again begins to flow but gradually falls off until it again becomes insignificant. By further increasing the voltage the cell may finally be brought to a state such that it will furnish a counter-emf. of several hundred volts. Just what voltage may be applied depends upon the kind of electrolyte used and its concentration. If large voltages are to be used, a saturated solution of borax is very satisfactory. A lead-aluminum cell with borax solution will withstand 300 volts without a breakdown. It follows that several cells in series would operate with several times this voltage.

With the ordinary Nodon arrangement of cells it has been customary to change the 110-volt alternating current to a pulsating direct current. The voltage limit for such a four-cell arrangement is easily seen to be the breakdown voltage of a single cell, since at any time the load potential plus the internal drop in one cell is in parallel with a single cell. When higher voltages are to be used, a group of several cells takes the place of each of the four cells in the Nodon arrangement. Fig. 1 shows such an arrangement with four cells in each group. *T* represents the transformer furnishing the alternating voltage. The authors usually employed ten cells in each group and an alternating emf. of 2200 volts. The long lines in the figure represent the aluminum plates and the short lines the lead plates. *L* signifies the load. The voltage at the load depends to a considerable extent upon the load current since the internal resistance is rather high. With small currents maximum values were as high as 3000 volts, while the square root of mean square value, as read by a Kelvin static instrument, was 2600 volts.

The second matter to be considered—viz., the wave form—was investigated by means of a Siemens & Halske oscillograph. The vibrators were calibrated so that voltages and currents could be read directly from the photographs with the same accuracy as was possible in measuring the ordinates of the curves. With the Nodon valve scheme it is found that when the load is non-inductive the current is completely rectified and never falls to a zero value at the minimum points. The fluctuation, however, is very large. To reduce this fluctuation in the value of the rectified current two methods readily suggest themselves — (a) the introduction of inductance in series with the load and (b) the placing of a condenser in parallel with the load. Fig. 3 shows the effect of inductance in series with the load. The lower curve is the voltage curve and the upper one the current curve. Fig. 4 shows two voltage curves and one current curve. Designate the curve that becomes tangent to the zero line as *e* and the one that goes silghtly below the zero line as *e'*. *e* is the voltage curve when the load is a non-inductive resistance and *e'* is the voltage curve with the same total resistance and in addition 33 millihenries of inductance. The upper curve is the current curve with the inductance in the circuit. The reason that *e'* falls below the zero line at the minimum points is because the emf. of self-induction is added to the emf. from the rectifier. The authors have been able to differentiate graphically the current curve and thereby to show that curve *e'* is made up two components one of which is *e* and the other Ldi/dt, *L* being the inductance and di/dt the time derivative of the current.

Fig. 5 is an oscillogram showing a current in the load of 2.5 amp. rectified with the four-cell combination. An inductance of 33 millihenries was placed in series with the load and a condenser of 25 mf. in parellel with it. The fluctuation from the mean value of the current is but little more than 1 per cent.

When high voltages are desired and small currents only are needed, the condenser without inductance gives satisfactory results. Fig. 6 shows the effect of capacity in such a case. The direct voltage in this case was 2800 volts



FIGS. 3, 4, 5 AND 6—RECTIFIED WAVES OF CURRENT AND VOLTAGE

(3) Voltage and current (above) with inductance in series with load. (4) Voltage waves with and without inductance. For non-inductive loads the voltage curve is never negative. Current wave (2.5 amp.) shown above. (5) Rectified current with inductance in series and condenser across load. (6) Voltage curves showing the steadying effect of condensers across the load.

and the current about 0.1 amp. The curve showing the larger fluctuation represents the voltage without a condenser, while the other one was obtained when a condenser of 2.8 mf. capacity was connected across the load.

Another arrangement of cells suggested by Schultz makes it possible to obtain direct voltages considerably more than twice as large as the effective value of the

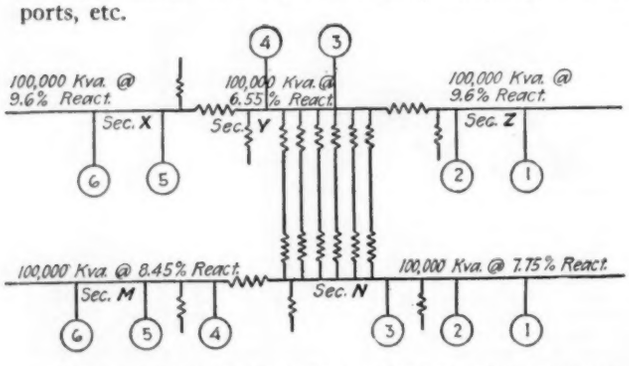
alternating emf. Fig. 2 shows the connections. The condensers were each of 2.8 mf. capacity. At the peak of one half cycle one of the condensers is charged to the maximum voltage produced by the transformer; *i.e.*, to 1.41 times the effective value of the voltage. At the peak of the next half cycle the other condenser receives an equal charge. The two condensers are in series, and hence the total potential difference, between the terminals *D* and *C* is $2 \times 1.41 \times E$, *E* being the effective value of the alternating voltage. This assumes the wave to be harmonic and the leakage to be insignificant. If 900 volts were applied the rectified voltage should be $2 \times 1.41 \times 900 = 2538$. The voltage actually measured under these conditions was 2250.

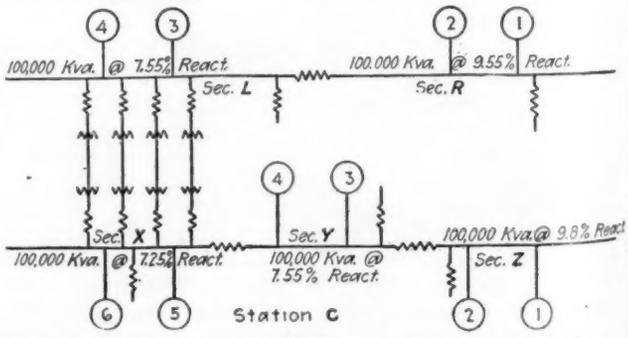
Calculating Short Circuits on Power Systems—II

A Scheme for Calculating Short-Circuit Current and Kva. in Large Power Systems Is Worked Out—The Selection of Circuit Breakers and the Design of Busbar Supports Depend Upon These Calculations

BY R. F. GOODING

THE calculation of short-circuit characteristics of each of three stations operating independently was carried out in the first section of this article. (See ELECTRICAL WORLD, Oct. 18.) The operation of the stations in parallel may now be investigated, and the method of selecting circuit breakers and designing bus supports explained. The stations will be taken in this order, "A" and "B," "A" and "C," "A," "B" and "C," and reactance diagrams will be made for each combination. In studying the combination of "A" and "B" results for Station "A" will first be found, then for Station "B," and these combined for the reactance diagram. The same procedure will be followed for Stations "A" and "C." Obviously there can be no combination of "B" and "C." When all three stations are operating it will be necessary to analyze each station in detail. The reactance diagram for the whole system is the most important of all these diagrams. In fact, having once obtained this final diagram, the engineer may discard those for the single stations. These single-station diagrams were very necessary as a means of obtaining the final system reactance diagram, but as the latter represents the worst conditions possible on the system, it is the one which should govern the application of circuit breakers, switches, bus supports, etc.





FIGS. 5 AND 6—REACTANCE DIAGRAMS FOR TWO STATIONS IN PARALLEL. (5) STATIONS "A" AND "B," (6) STATIONS "A" AND "C."

STATIONS "A" AND "B" IN PARALLEL

Station "A," Section "Y."—The equivalent reactance of Section "N" of Station "B" bus (see Fig. 3) is 10 per cent at 100,000 kva. Six tie lines from Station "A" to Station "B," each of 8000 kva. at 12.5 per cent reactance (5 per cent artificial and 7½ per cent in cable itself) would represent 100,000 kva. at 26 per cent reactance. By adding these reactances, we find the power from Station "B" to Station "A" = 100,000 kva. at 36 per cent reactance (= 22,000 kva. at 8 per cent reactance). This amount added to power on Section "Y" (100,000 kva. at 8 per cent reactance) gives 122,000 kva. at 8 per cent reactance = 100,000 kva. at 6.55 per cent reactance. This gives 1,525,000 arc kva. = 67,000 arc amp.

Power on Section "X."—In determining the power on Section "X" we proceed just as when Station "A" was operating alone, except that the power from Station "B" to Section "Y" must be included.

		Kva.	Per Cent Reactance
Power from Section "Z" to Section "Y"	=	50,000	16
Power from generators 3 and 4	=	100.000	16
Power from station "B"	=	44,000	16
Power on Section "Y"	=	194,000	16
	=	100,000	8.25
Bus reactance	=	100,000	16
Power from Section "Y" to Section "X"	=	100.000	24.25
	=	66,000	16
Power from generators 5 and 6	=	100,000	16
Total power on Section "X"	=	166,000	16
	=	100,000	9.6
100,000 kva. at 9.6 per cent reactance	=	1,040,000 arc kva., or 44,600 arc. amp.	

Power on Section "Z."—Power on Section "Z" would be exactly the same as for Section "X."

Radial Feeder, Section "Y."

		Kva.	Per Cent Reactance
Power on bus	=	100,000	6.55
Feeder reactance, 8000 kva. at 2.5 per cent reactance	=	100,000	31.25

Power on feeder	= 100,000	37.8

100,000 kva. at 37.8 per cent reactance = 265,000 arc kva., or 11,600 arc amp.

Radial Feeder, Section "X" or Section "Z."—Similarly power on feeder = 100,000 kva. at 40.85 per cent reactance.

100,000 kva. at 40.85 per cent reactance = 244,000 arc kva., or 10,700 arc amp.

Station "B" to Section "N."—

Power on Section "Y," Station "A" bus	= 100,000	8
Six tie lines, 48,000 kva. at 12.5 per cent reactance	= 100,000	26
Power from Station "A" to Station "B"	= 100,000	34
	= 29,500	10
Power on Section "N," Station "B"	= 100,000	10
Total power on Section "N"	= 129,500	10
	= 100,000	7.75

100,000 kva. at 7.75 per cent reactance = 1,290,000 arc kva., or 56,500 arc amp.

Section "M."—

Power from Station "A" to Station "B"	= 100,000	34
	= 35,400	12
Generators 1, 2, 3	= 80,000	12
Power Section "N"	= 115,400	12
	= 100,000	10.4
Bus reactance	= 100,000	18
Power Section "N" to Section "M"	= 100,000	28.4
	= 42,000	12
Generators 4, 5, 6	= 100,000	12
Total power Section "M"	= 142,000	12
	= 100,000	8.45

100,000 kva. at 8.45 per cent reactance = 1,180,000 arc kva., or 52,000 arc amp.

Radial Feeder, Section "N."—

Power on bus	= 100,000	7.75
Feeder reactance	= 100,000	31.25
Power on feeder	= 100,000	39

100,000 kva. at 39 per cent reactance = 256,000 arc kva., or 11,200 arc amp.

Radial Feeder, Section "M."—

Power on bus	= 100,000	8.45
Feeder reactance	= 100,000	31.25
Power on feeder	= 100,000	39.7

100,000 kva. at 39.7 per cent reactance = 252,000 arc kva., or 11,000 arc amp.

Short Circuit in Generator.—The amount of power that would be "pumped" into a generator in case of internal trouble can be ascertained by subtracting the short-circuit amperes of the generator in question from the total for that particular section of bus.

Fig. 5 is the reactance diagram for Stations "A" and "B" operating together.

STATIONS "A" AND "C" IN PARALLEL

Inasmuch as the calculations follow readily from the results for Stations "A" and "B" in parallel, only results will be set down for this case.

Station "A," Section "X."—The reactance of each high-tension line between Stations "A" and "C" is 20 per cent at 30,000 kva. Four of these lines would represent 120,000 kva. at 20 per cent reactance = 100,000 kva. at 16.7 per cent reactance.

	Kva.	Per Cent Reactance
Power on Section "L," Station "C"	= 100,000	10.5
Total power on Section "X"	= 138,000	10
	= 100,000	7.25

100,000 kva. at 7.25 per cent reactance = 1,380,000 arc kva., or 60,500 arc amp.

Section "Y."—

Power from Station "C" to Section "X"	= 100,000	27.2
Total power on Section "Y"	= 211,500	16
	= 100,000	7.55

100,000 kva. at 7.55 per cent reactance = 1,320,000 arc kva., or 58,000 arc amp.

Section "Z."—

Power from Section "X" and Station "C" to Section "Y"	= 61,500	16
Total power Section "Z"	= 163,000	16
	= 100,000	9.8

100,000 kva. at 9.8 per cent reactance = 1,020,000 arc kva., or 44,700 arc amp.

Radial Feeder, Section "X."—

Power on bus Section "X"	= 100,000	7.25

100,000 kva. at 38.5 per cent reactance = 260,000 arc kva., or 11,400 arc amp.

Radial Feeder, Section "Y."—

100,000 kva. at 38.8 per cent reactance = 257,000 arc kva., or 11,200 arc amp.

Radial Feeder, Section "Z."—

100,000 kva. at 41.05 per cent reactance = 244,000 arc kva., or 10,700 arc amp.

Station "C," Section "L."—

Power on Section "X," Station "A"	= 100,000	10

100,000 kva. at 7.55 per cent reactance = 1,325,000 arc kva., or 58,200 arc amp.

Section "R."—

Power from Station "A"	= 100,000	26.7

100,000 kva. at 9.55 per cent reactance = 1,050,000 arc kva., or 46,000 arc amp.

Radial Feeder, Section "L."—

100,000 kva. at 38.8 per cent reactance = 258,000 arc kva., or 11,300 arc amp.

Radial Feeder, Section "R."—

100,000 kva. at 40.8 per cent reactance = 245,000 arc kva., or 10,700 arc amp.

Reactance diagram for Stations "A" and "C" operating together is shown in Fig. 6.

ALL STATIONS IN PARALLEL

When the system with all three stations operating is considered, it will be found that conditions at Stations "B" and "C" do not increase a great deal over the values for "A" and "B" or "A" and "C." This is due to the fact that any power that Station "B" can supply to Station "C" or vice versa must pass through one bus reactance in

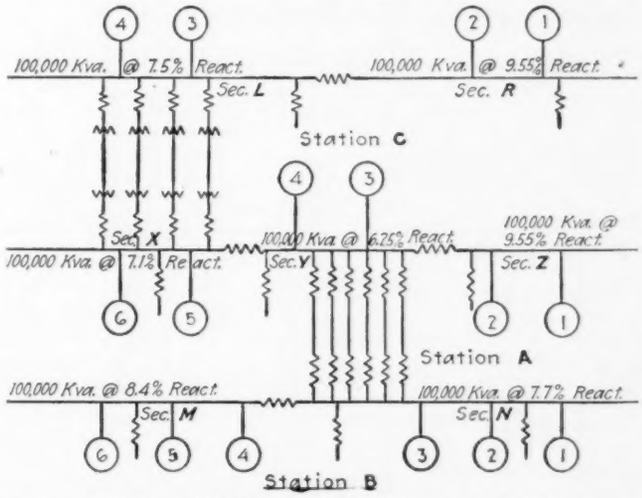


FIG. 7—FINAL REACTANCE DIAGRAM—ALL STATIONS IN PARALLEL.

These data should be used for determining oil switch capacities and for calculating forces acting on bus supports during short circuit.

Station "A" and then over the same cables or lines as power from Station "A." The power on Section "X" with Station "A" operating alone is 100,000 kva. at 10 per cent reactance, and with Station "B" in parallel with

Station "A" the reactance value for Section "X" is reduced only from 10 per cent to 9.6 per cent. Obviously such a small variation at Section "X" of Station "A" will have practically no effect on the power delivered from Station "A" to Station "C."

Similarly, the power on Section "Y" of Station "A" bus with "A" operating alone is 100,000 kva. at 8 per cent (Fig. 2). With "C" in parallel with "A," this figure is reduced to 7.55 per cent, so the additional power on Station "B" bus due to Station "C" is negligible. Not so, however, with Station "A." As it is located between the other two stations, conditions here are much more severe with all stations operating than with only two.

Station "A," Section "X."—From Fig. 5 we find the power on Section "X" with Stations "A" and "B" running to be 100,000 kva. at 9.6 per cent reactance. Now the power that Station "C" can deliver to Station "A" = 100,000 kva. at 27.2 per cent reactance = 35,300 kva. at 9.6 per cent reactance.

		Kva.	Per Cent Reactance.
Power on Section "X"	=	100,000	9.6
Power from "C" to "A," 100,000 kva. at 27.2 per cent reactance	=	35,300	9.6
Total power Section "X"	=	135,300	9.6
	=	100,000	7.1

100,000 kva. at 7.1 per cent reactance = 1,410,000 arc kva., or 62,000 arc amp.

Section "Y."—Power on section "Y" with Stations "C" and "A" running = 100,000 kva. at 7.55 per cent reactance.

Power from Station "B" to Station "A"	=	100,000	36
	=	21,000	7.55
Power on Section "Y"	=	100,000	7.55
Power from Station "B"	=	21,000	7.55
Total power Section "Y"	=	121,000	7.55
	=	100,000	6.25

100,000 kva. at 6.25 per cent reactance = 1,600,000 arc kva., or 70,000 arc amp.

Section "Z."—

Power from Station "C" to Section "X"	=	100,000	27.2
	=	59,000	16
Power from generators 5, 6	=	100,000	16
Total power Section "X"	=	159,000	16
	=	100,000	10.1
Bus reactance	=	100,000	16
Power from Section "X" to Section "Y"	=	100,000	26.1
	=	61,500	16
Power from "B" to "A" (100,000 kva. at 36 per cent reactance)	=	44,500	16
Power from generators 3, 4	=	100,000	16
Power Section "Y"	=	206,000	16
	=	100,000	7.75
Power on Section "Y"	=	100,000	7.75
Bus reactance	=	100,000	16
Power from Section "Y" to Section "Z"	=	100,000	23.75
	=	67,500	16
Power from generators 1, 2	=	100,000	16
Total power Section "Z"	=	167,500	16
	=	100,000	9.55

100,000 kva. at 9.55 per cent reactance = 1,050,000 arc kva., or 46,000 arc amp.

Radial Feeder, Section "X."—

Power on Bus Section "X"	=	100,000	7.1

100,000 kva. at 38.35 per cent reactance = 260,000 arc kva., or 11,400 arc amp.

Radial Feeder, Section "Y."—

Power on Section "Y"	=	100,000	6.25

100,000 kva. at 37.5 per cent reactance = 267,000 arc kva., or 11,700 arc amp.

Radial Feeder, Section "Z."—

Power on bus	=	100,000	9.55

100,000 kva. at 40.8 per cent reactance = 245,000 arc kva., or 10,700 arc amp.

Station "B," Section "N."—Power on Section "Y" of Station "A" with "A" and "C" operating (see Fig. 6) is 100,000 kva. at 7.55 per cent reactance. The six tie lines from Station "A" to Station "B" have a reactance of 26 per cent at 100,000 kva.

		Kva.	Per Cent Reactance.
Power on Section "Y"	=	100,000	7.55
Six tie lines		100,000	26
Power from "A" and "C" to "B"	=	100,000	33.55
Power on Section "N"	=	100,000	10
Power from Stations "C" and "A" to Station "B" (100,000 kva. at 33.55 per cent reactance)	=	29,800	10
Total power Section "N"	=	129,800	10
	=	100,000	7.7

100,000 kva. at 7.7 per cent reactance = 1,300,000 arc kva., or 57,000 arc amp.

Section "M."—

Power from Stations "A" and "C" to "B" 100,00 kva. at 33.55 per cent reactance	=	44,800	15
Power from Generators 1, 2, 3	=	100,000	51
Power Section "N"	=	144,800	15
	=	100,000	10.3
Bus reactance	=	100,000	18
Power from Section "N" to Section "M"	=	100,000	28.3
	=	42,500	12
Power from generators 4, 5, 6	=	100,000	12
Total power Section "M"	=	142,500	12
	=	100,000	8.4

100,000 kva. at 8.4 per cent reactance = 1,190,000 arc kva., or 52,300 arc amp.

Radial Feeder, Section "N."—

Power on bus	=	100,000	7.7
Feeder reactance	=	100,000	31.25
Power on feeder	=	100,000	38.95

100,000 kva. at 38.95 per cent reactance = 257,000 arc kva., or 11,200 arc amp.

Radial Feeder, Section "M."—

Power on bus	=	100,000	38.4

100,000 kva. at 39.65 per cent reactance = 251,000 arc kva., or 10,900 arc amp.

Station "C," Section "L."—Power on Section "X" of Station "A" with "A" and "B" in parallel, 100,000 kva. at 9.6 per cent reactance (see Fig. 5).

		Kva.	Per Cent Reactance.
Power on Station "A" bus	=	100,000	9.6
Four high-tension lines, Station "A" to Station "C"	=	100,000	16.7
Power from Stations "A" and "B" to Station "C"	=	100,000	26.3

The power on Section "L" with Station "C" operation alone is 100,000 kva. at 10.5 per cent reactance. Then:

		Kva.	Per Cent Reactance.
Power on bus Section "L"	=	100,000	10.5
Power from Station "A" and "B" to Station "C" (100,000 kva. at 26.3 per cent reactance)	=	40,000	10.5
Total power Section "L"	=	140,000	10.5
	=	100,000	7.5

100,000 kva. at 7.5 per cent reactance = 1,333,000 arc kva., or 58,500 arc amp.

Section "R."—

Power from Station "A" and Station "B"	= 100,000	26.3
	= 62,000	16.5
Generators 3, 4	= 100,000	16.5
Power Section "L"	= 162,000	16.5
	= 100,000	10.2
Bus reactance	= 100,000	12.5
Power from Section "L" to Section "R"	= 100,000	22.7
	= 72,500	16.5
Generators 1, 2	= 100,000	16.5
Total power Section "R"	= 172,500	16.5
	= 100,000	9.55

100,000 kva. at 9.55 per cent reactance = 1,050,000 arc kva., or 46,000 arc amp.

Radial Feeder, Section "L."—

Power on Section "L" ..... = 100,000 7.55

100,000 kva. at 38.8 per cent reactance = 258,000 arc kva., or 11,300 arc amp.

Radial Feeder, Section "R."—

Power on Section "R" ..... = 100,000 9.55

100,000 kva. at 40.8 per cent reactance = 245,000 arc kva., or 10,700 arc amp.

Fig. 7 shows results just obtained and may be termed the system reactance diagram. For practical application one would hardly care to carry decimals to two places and would very probably give these values to the nearest 5/10. For instance, 9.55 per cent would be 9.5 per cent, while 6.25 per cent would be 6.00 per cent. This would give a difference of perhaps several hundred amperes in results obtained, but a few hundred amperes more or less would hardly be noticed in the values obtained.

Application of Reactance Diagram

With such data available as are shown in Fig. 7 we can determine at a glance just where the greatest short-circuit stresses will come and can design bus compartments and select circuit breakers accordingly. We see that Section "Y" of Station "A" bus has the lowest equivalent reactance and Section "Z" of the same bus the highest. This means then that the most violent disturbances will come on Section "Y" and the least violent on Section "Z."

It has been explained in an earlier paragraph that the generators, reactances, etc., are all assumed values. In actual practice the tendency would be to use more reactance and reduce the short-circuit values to considerably less than those we have obtained. It must be remembered in this connection that the force exerted on the busbars or in the breakers themselves varies as the square of the current. This being the case, it is easy to explain the tendency just mentioned.

Considering Section "Y" on Station "A" bus, we find that a bus short circuit (if mechanically possible) would give a current of 70,000 amp. at 13,200 volts, and this on the basis of a symmetrical short circuit. However, for the first few cycles the short may be entirely unsymmetrical and reach a value of one and a half to two times that for symmetrical short circuits. To be on the safe side, let us assume the unsymmetrical short to have twice the value of the symmetrical short. This double value may last only one or two cycles, and all trace of dissymmetry will no doubt disappear long before any circuit breaker opens; therefore, unsymmetrical short circuits may be disregarded so far as circuit breakers are concerned. However, when one comes to consider the bus supports, etc., this double value has a most decided bearing, as it means four times the stress on supports, etc., that would result from a symmetrical short. It would be well, therefore, to figure stresses on bus supports, etc., on the basis of a current of 140,000 amp. Assuming a spacing of 18 in. (46 cm.) between buses arranged in a plane, the force per foot of bus would $= F =$

$$\frac{(140{,}000)^2 \times 10^{-7} \times 8.08}{18} = 880 \text{ lb. (400 kg.)}$$

When it comes to using the system reactance diagram for the purpose of approximating the actual duty on the oil circuit breakers, the time required for the breaker to open has a decided bearing and should be considered. It has been customary to assume that the breakers would open in 0.25 to 0.3 second, and that by this time the short-circuit current would have decreased to 50 per cent of its initial (symmetrical) value. This gives a very close approximation and is near enough for most purposes. Curves have been published (A. I. E. E., February, 1918) showing currents obtained from generators at different time periods for various reactances. However, as the lowest reactance given is 8 per cent, these curves would hardly be applicable here.

As a matter of fact, with reactances on every feeder, no circuit breaker would have to rupture the entire bus short circuit. If a short circuit should occur between a feeder breaker and the feeder reactance, this statement would not hold good; but this possibility is so remote that it is never considered. If a short circuit occurs in a generator winding, its breaker (opening from the action of the differential relays) would have to interrupt an amount equal to the bus short circuit minus its own short-circuit amperes. In the case of Section "Y" this would amount to 70,000 — 13,000 = 57,000 amp., and as this would decrease 50 per cent by the time the breaker opened, this would give 23,500 amp. as the actual duty on this breaker. Duty on generator breakers for any other bus section would be found in a similar way.

*"Repulsion Between Busbars," by Leonard and Riker. *Electric Journal*, December, 1917.

WAKEFIELD LOCAL BOARD RAISES ELECTRIC RATES

Massachusetts Municipality Advances Schedule for Energy Sold to Consumers—Higher Cost Based on Advance in Coal

Increased costs have led the municipal light board of Wakefield, Mass., to announce a rate increase effective on Nov. 1 bills.

Henceforth electricity will be sold at 15 cents per kilowatt-hour with a discount of 2 cents for prompt payment, in general service. The rate for motors, signs, etc., will be 11 cents with a discount of 2 cents for prompt payment. An electric range service rate of 10 cents per kilowatt-hour for the first 20 kw.-hr. used and 5 cents for all energy above this, with a minimum charge of $2 per month and a discount of 1 cent for payment within fifteen days, has been established.

The town purchased 924,600 kw.-hr. from the Edison Electric Illuminating Company of Boston in 1918 at a rate of 2.48 cents per kilowatt-hour. On account of the increased cost of coal at the L Street station of the Edison company, the present rate paid by the town averages 3.18 cents. Enregy is supplied at 4600 volts from the Woburn substation of the Edison company. The former net rate was 10 cents, with a minimum charge of $9 per meter per year.

A Glance Into the Future

Increasing Power Demand and Rapid Exhaustion of High-Grade Coal Mines May Cause Industries to Move Where Adequate Power Is Available—Water Power and Interconnection Will Delay the Day

BY GEORGE H. ASHLEY
State Geologist of Pennsylvania.

IT MAY come as a shock to many people to hear any one say that unless power conditions change very materially in the next fifty years the industrial supremacy of America will not only pass from the Atlantic Coast to the Central States but with it may go a large share of the power-using industries themselves. However, that is what the writer fears.

During the last thirty years there has been a remarkable industrial development in the Central West, following the discovery of natural gas in Indiana and Ohio and the development of the by-product coking plant, which can utilize Illinois coal in the making of metallurgical coke, and because of other factors. This development has in the main been in addition to the industrial development in the East and not at its expense. But to-day we are facing a situation, not yet acute, that may mean the virtual withdrawal of vast industries from the East and their re-establishment in the West and South, owing to the approaching exhaustion of cheap coal in the East.

When it is said that there are three and one-half trillion tons of coal in the United States and that we are using only about half a billion a year it would seem that there was coal enough to last this country for at least 7000 years. It should be remembered, however, that one trillion tons of this coal is only "half-baked" coal, or lignite (nearly one-half water), that another trillion tons is only three-fourths baked (likewise about one-fourth water), and that of the rest of the coal we have been taking not only the cream but really the double cream. It will be but a few years before we shall have skimmed off the cream and will come to the skimmed milk, as it were. When that takes place something is going to happen.

Why the East Has Had Industrial Supremacy

It may be well to face the facts. The industrial East has maintained its supremacy because of cheap fuel and nearness to markets. Because of cheap fuel Pittsburgh could afford to haul iron ore from Minnesota. What will happen when cheap fuel disappears in the East, though continuing in the Middle West? It does not take a seer nor even a scientist to point out that if our present increased use of power continues a generation will see the exhaustion of cheap fuel in the East.

The price fixing of coals by the government during the war brought out very distinctly the difference between cheap coals and high-priced coals. Thus prices allowed for run-of-mine coal from Ohio by the Fuel Administration ranged from $2 to $3.75 a ton. The first is a cheaply mined coal, the last a high-priced coal. Prices in Kentucky ranged from $1.95 to $3.55; in Illinois from $1.95 to $2.65. It is obvious that the industry of any region is built up on its low-priced fuels, other things being equal.

*Formerly geologist in charge of section of Eastern coal fields, U. S. Geological Survey.

High-priced coals have as a rule no greater heating power than the low-priced coals from the same region and sell only to the household or other special trade. What will happen when Pittsburgh must pay double what Chicago pays a ton for steam coal? Does that seem improbable? Then consider certain facts. First, low-priced fuel comes only from thick regular beds. The cost of mining coal from a bed 3 ft. (0.9 m.) thick is about one and one-half times the cost of mining a bed 6 ft. to 8 ft. (1.8 m. to 2.4 m.) thick, and a bed 2 ft. (0.6 m.) thick will cost twice as much to mine as a thick bed. Second, up to the present the bulk of the coal used for power has come from thick, regular beds. The Pittsburgh bed has a thickness of from 7 ft. to 9 ft. (2.1 m. to 2.7 m.); the Pocahontas No. 3 bed, which is the principal source of Pocahontas coal, has a thickness of from 4 ft. to 11 ft. (1.2 m. to 3.4 m.), and in general it may be said that nearly all of the steam coal used in the eastern United States in the past has come from beds from 4 ft. to 14 ft. (1.2 m. to 4.3 m.) thick.

Diminution of Thick Coal Beds

A review of the field to-day shows that in several of the districts practically all of the thick coal has been mined out, while in others it is possible to count the years to the time when the supply will be gone. Thus the original basin of Moshannon coal in Clearfield County, Pa., on which the reputation of Clearfield coal was built, is practically exhausted. Even the coal left in the early mining has been recovered. The "Big Vein" of the George's Creek region is nearly gone, and steam shovels are cleaning up the coal left on the outcrop. And so with many others.

The big surprise comes when we turn to the great producing areas of the present. For fifty years or more the Pittsburgh bed of Pennsylvania has produced about one-fifth of all the coal mined in the United States, and in 1913 it produced about 7 per cent of the world's total production. Presented in another way, the production from the Pittsburgh bed in southwestern Pennsylvania in 1913 (the last year before the war) was about three times the production from the whole State of Ohio, five times that from all of Indiana, nearly twice that of Illinois, nearly five times that of Kentucky or Alabama or Colorado, and one and one-half times that of West Virginia, or more than all of the other States not named put together. Comparing the production from that bed with the production in foreign fields, we find that from that one bed was produced nearly one-third as much coal as was mined in Great Britain, more than one-third as much as was mined in Germany, nearly twice as much as was mined in Austria-Hungary, more than twice as much as was mined in France. Obviously the Pittsburgh bed is of some importance to the industry in the northeastern part of the United States, particularly as Pennsylvania

contains no other persistently thick bed. Yet at the present rate of mining a generation will see the end of the Pittsburgh coal in Pennsylvania.

In 1881 H. M. Chance made a careful estimate of the coal in Pennsylvania and assigned to the Pittsburgh bed 839,200 acres (339,000 hectares), containing 10,500,000,000 tons of coal, or about one-third of the bituminous coal of the state. He did not include coal below a depth of 400 ft. (122 m.). Adding to that the known area of coal below 400 ft. increases the acreage by 54,000 (22,000 hectares) and the tonnage by 648,000,000, giving a total acreage of 893,200 (361,000 hectares) and a tonnage of more than 11,000,000,000. Four years later the total production of bituminous coal in Pennsylvania was about 20,000,000 tons, of which the Pittsburgh district produced about one-half. At that rate the Pittsburgh bed should have furnished coal for 1000 years. But since then the output from the Pittsburgh field has increased tenfold, so that when, in 1907, John W. Boileau reviewed the situation he found left unmined 522,000 acres (211,000 hectares), from which could be recovered 4,500,000,000 tons. In the few years since his estimate was made the actual figures of production show that more than 1,000,000,000 tons of that amount have been removed and the coal is to-day being taken at a rate of 100,000,000 tons a year. It does not take an actuary to compute that if that rate be maintained but not increased the Pittsburgh bed in Pennsylvania will be all gone in thirty-five years.

New Coal Fields Not Likely To Be Discovered

It will be asked, are there not other coal beds below the Pittsburgh bed? Drilling around Pittsburgh has so far failed to reveal any. Oil wells report 6 ft. (1.8 m.) of coal in the southwest corner of the state. This is probably the Upper Freeport coal, which is thick where it outcrops to the east and south, but in those areas it is badly shot to pieces with bands of shale.

If similar studies are made of the Pocahontas and other well-known fields, somewhat similar conditions are found. Production did not start in the Pocahontas field until early in the eighties of the last century, so that the field is not so nearly exhausted nor is the exhaustion going on so rapidly as in the Pittsburgh field. Where in the Pittsburgh field 10,000 acres (4,000 hectares) a year are being mined out, in the Pocahontas field only about 3500 acres (1400 hectares) are being taken. On the other hand, while the production from the Pittsburgh bed seems to have about reached its maximum, if indeed it did not pass it in 1913, the production from the Pocahontas field is steadily increasing. Recent detailed surveys covering the whole of the Pocahontas field in Virginia and West Virginia show that, including all the beds over 4 ft. (1.2 m.) thick, there remains to-day about 2,000,000,000 tons of Pocahontas coal, with about 1,500,000,000 tons in thinner beds.

At present the annual depletion of all the Pocahontas beds in West Virginia and Virginia is at the rate of 22,000,000 tons a year. At that rate the thick beds would last ninety years and all the beds 160 years. However, the rate of mining in that field has been rapidly increasing, and if account be taken of this increased production and it be assumed that the production will continue to increase at the same general rate of increase of recent years, the whole field will last but sixty years, including both thick and thin beds. At present production is coming almost exclusively from the thick beds ranging from 4 ft. to 12 ft. (1.2 m. to 3.7 m.) thick, with an average of 6 ft. (1.8 m.) or better, so that it is evident that the thick beds which yield the cheap coal will be gone in about a generation, or probably about the same time as the Pittsburgh bed. As a matter of fact, neither field will be exhausted suddenly. As the limits are approached the production will fall off and the end will come slowly, but the practical effect will be the same.

Possibility of Water Power Relieving Coal Situation

It may be argued that as the cost of coal increases the manufacturing interests of the East will turn to water power. That argument leads to the question of the adequacy of the water power of that region to take over the burden now carried by coal. According to the last census of the total power capacity of the Northeast section, in which are included New England, New York, New Jersey and Pennsylvania, there was in 1912 12,375,000 hp., of which steam supplied 9,666,000 hp. According to O. C. Merrill, the maximum developable water power of New England, New York, New Jersey and Pennsylvania is roundly 4,000,000 hp. (the Merrill figures are a revision of earlier figures prepared by the United States Geological Survey). If these figures are analyzed, it will be found that they do not represent the maximum possible development but the maximum economic development. For example, the figures given for Pennsylvania are 684,000 hp., of which in 1917 173,000 hp. was developed. But studies by the State Water Supply Commission indicate that by the building of large storage reservoirs to equalize the flow at all seasons it may be possible to double the Merrill estimate.

For New York State Merrill used the figure 1,698,000 hp. The State engineers estimate that with possible storage there may be developed 1,500,000 hp., exclusive of the Niagara and St. Lawrence Rivers. The use of Niagara Falls by the United States is restricted by a treaty with Great Britain to 20,000 second-cubic-feet (56 cu. m. per second). If the total fall of 336 ft. (102 m.) from Buffalo to Lewiston were utilized, this would give 570,000 hp. As a matter of fact, the two main companies are using only 202.4 ft. (61.6 m.) of head—138.5 ft. (42.2 m.) respectively—one developing 66,000 hp. and the other having an installation of 110,500 hp. Some day Niagara Falls may "fall" only on Sundays as a spectacle, and on other days the whole volume will be led by great canals to a spot above the Devil's Hole, allowing the development on both sides of the river of 5,500,000 hp. Or the rim of the fall may be evened up so as to give even depth of flow, as over the American fall at present, so that 80 per cent of the flow can be utilized all the time, yielding all told about 4,500,000 hp., of which New York will be entitled to at least 2,000,000 hp. The St. Lawrence follows the New York boundary for many miles and in that stretch has a descent of 92 ft. (28 m.) that, it is estimated, could yield 1,230,000 hp., of which New York will be entitled to one-half. At present 86,000 hp. is being developed.

Importation of Hydroelectric Power from Canada

In addition to these powers within the boundaries of the northeastern United States, there are large powers to the north in Canada. The St. Lawrence below the

international boundary is estimated to have a potential horsepower of nearly 1,500,000, and the two provinces of Quebec and Ontario have been estimated to have a maximum of 6,000,000 hp., each, including that from Niagara and the St. Lawrence. Already 125,000 hp. is imported into New York from Ontario, and a small amount is imported into New England. If all of the Canadian water powers were developed and Canada would allow the exportation of, say, one-half the power, or 6,000,000 hp., it is probable that the northeastern corner of the United States could look forward to an ultimate utilization of not less than 10,000,000 to 12,000,000 water horsepower. As this amount would be continuous, it might be possible by the time distribution of the load to make that initial horsepower carry the equivalent of 13,000,000 to 15,000,000 hp. demands. Subtracting the 2,000,000 hp. now developed, there is left 11,000,000 hp. to 13,000,000 hp. to replace the 10,000,000 hp. in that area now depending on coal.

But the problem is not so simple. Just as the most cheaply mined coals have been taken first, so the most cheaply developable water powers have been those already taken up. Additional water power will undoubtedly be harnessed at an ever-increasing cost. As a matter of fact, in the New England and Middle Atlantic States the use of steam power has been increasing faster than the use of water power. The introduction of giant turbine generators of up to 60,000 kw. capacity has greatly increased the efficient use of steam.

Power Demand Increasing Enormously

In the second place the demand for power has been increasing rapidly from year to year and is bound to increase even more in the future. Our use of power is the truest mark of our material prosperity, and the tendency to substitute mechanical power for hand or horse labor is a growing one. It may confidently be expected that the past increase in power production will continue into the future, and that the major part of this demand will be met by coal until the increasing cost of coal, due to the exhausting of the thicker beds, begins to throw a larger part of the burden on water power. But meanwhile our use of power may well be imagined to have crept up from 12,000,000 hp. in the area under consideration to 20,000,000 hp. or even 30,000,000 hp., the bulk of which will still be carried by coal.

The use of coal has been doubling every ten years or thereabouts since 1840. Notice these figures, which represent the production of the United States in millions of tons: 1840, 2; 1850, 7; 1860, 14; 1870, 33; 1880, 71; 1890, 157; 1900, 269; 1910, 501; 1918, 685. It is true the progression has not quite kept up in recent years, but if we remember that this increased use of coal largely represents the increased demand for power, it must be evident that it will not be many years until we are using 20,000,000 or 30,000,000 hp. Let us put the period at thirty years.

What will be the situation? The great Pittsburgh coal bed will be approaching exhaustion (or will have been exhausted if the present rate of mining be increased). Practically all of the thick coals of Pennsylvania, Maryland, Virginia and possibly West Virginia will have been exhausted or will be approaching exhaustion, and coal in the East will probably have doubled or tripled in price. The more recently developed water power will be selling at greatly increased prices because of the increased cost of installation. When that time comes, or as it approaches, it must be obvious that power in the East must more and more be reserved for public service and manufacturing will be squeezed out of that section to the South and the West.

Industries Will Be Forced to Migrate

Why to the South and West? Because in those directions lie the great sources of power, both coal and water power. Pennsylvania has been carrying more than her share of the burden. In 1880 Pennsylvania supplied two-thirds of all the coal mined in the United States, though it has been estimated that Pennsylvania never had more than 3 per cent of the coal found in the United States. Other states have gradually taken up the burden, more and more rapidly in recent years. Thus in 1885 Pennsylvania dug nearly seven times as much coal as Illinois and eighteen times as much as West Virginia. In 1918 each of those states produced practically one-third as much as Pennsylvania.

A. Bement has estimated that there are in the State of Illinois more than 6,000,000,000 tons of very thick coal, averaging, say, 9 ft. (2.7 m.); over 30,000,000,000 tons of thick coal, averaging 6 ft. to 7 ft. (1.8 m. to 2.1 m.); 65,000,000,000 tons of medium coal, averaging 4 ft. (1.2 m.) thick, besides about 100,000,000,000 tons of coal in 3-ft. (0.9-m.) or thinner beds. The same beds extend over into Indiana and west Kentucky, though covering much smaller areas. Recent computations by Frank Clark indicate that in Ohio there are 25,000,000,000 tons of coal 4 ft. (1.2 m.) or more thick, and 29,000,000,000 tons in beds 3 ft. to 4 ft. (0.9 m. to 1.2 m.) thick, besides the thinner beds.

The Central States are lacking in water power, but in the southern Appalachians there is estimated to be about 4,000,000 water horsepower, while in the Far West there is estimated to be more than 16,000,000 hp. in the Rocky Mountain States and over 23,000,000 hp. in the Pacific Coast States.

Is it not, therefore, clearly obvious that either manufacturing must in a large measure move westward, leaving the power sources of the East for public service, or else there must be a revolution in our use of coal? It has been shown in a recent paper that the electrification of our railroads might make a saving of 73,000,000 tons of coal a year. To-day we use on the average from 4 lb. to 8 lb. of coal to produce a kilowatt-hour. Modern practice in large power plants is reducing that to around 2 lb. (0.9 kg.), and one plant recently installed claims to have reached an efficiency of 1 kw.-hr. for 1.4 lb. (0.4 kg.) of coal. These figures point the way to enormous economies. The conversion of coal into producer gas and the use of that gas in the gas engine may permit still greater saving.

The Alternatives Presented

This phase of the subject will not be discussed, however, because it has been the purpose of this paper simply to present certain facts that seem to imply that it is the part of the men interested in industrial power in the East to discover and adopt measures for greatly increasing the efficiency of our use of coal, or else prepare to pack their kit bags and move westward, following the course of empire.

STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

WEEK BRUSH SPRINGS CAUSE BAD CASE OF SPARKING

Origin of This Trouble Is Often Difficult to Trace —Discovery Aided by Observing Accompanying Symptoms

BY E. C. PARHAM

Direct-current motor-brush sparking that is due to an actual open circuit in the armature winding is generally not difficult to diagnose, because a vicious spark can be observed to persist between the bars that are affected by the fault. This spark may appear to travel with the commutator. The voltage generated in an armature coil is not sufficient to start an arc across the intervening mica but may be sufficient to maintain an arc that has been established. Sparking that is due to a number of poor connections of armature leads is not so easy to diagnose with certainty, because sparking due to weak field, sparking from wrongly spaced brushes and sparking from overload may be very similar in character. Other symptoms usually must be sought to differentiate the several possible causes of brush sparking that may not be very vicious.

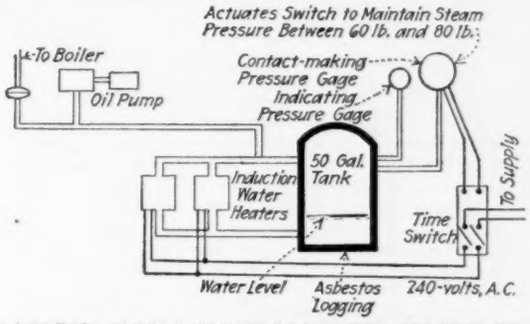
In a certain instance the accompanying symptom that suggested the immediate cause of sparking trouble was a belt of solder around the inner side of the motor frame in line with the armature connections. The inference was that not very much solder could be left in the connections when so much apparently had been thrown out of them. A bar-to-bar test proved the inference to be well founded. Accordingly, the connections were thoroughly resoldered. On reinstalling the armature and again starting, serious general sparking still persisted, especially during the period of acceleration, although the motor had no appreciable connected load. After wasting considerable time in seeking the cause in almost every place excepting the right one, it was located in an unsuspected place that should have been among the first inspected. On pressing down with two sticks on two brushes of opposite polarity all sparking was at once eliminated, showing the sparking to be due entirely to bad contact between the brushes and the commutator. Inspection then disclosed that the brush-holder springs had lost their temper.

ELECTRIC WATER HEATERS USED TO GENERATE STEAM

Controlled by a Time Switch, They Produce the Necessary Steam for Operating Boiler Oil Pumps Without Manual Observation

Where oil is fired under a boiler it is necessary to have steam to operate the oil pump and burner before the burner can be lighted. This necessitates firing with wood or coal for an hour and a half in the morning to get up steam. This not only requires half a cord of wood, in case wood is used, but makes it necessary for the fireman to come on duty two hours and a half before the regular day shift starts to work.

In order to save fuel and to obviate the necessity of paying the fireman overtime, a Portland candy manufacturer uses two 10-kw. induction electric water heaters to generate sufficient steam to operate the oil pump and



LINE SWITCH CLOSES ELECTRIC HEATER CIRCUIT SO THAT STEAM IS AVAILABLE WHEN FACTORY OPENS

burner. These heaters are thrown on by means of a time switch and the pressure is controlled with a contact-making pressure gage which is set to cut in the heaters at 60 lb. (4.5 kg.) pressure and cut them out at 80 lb. (5.5 kg.) pressure.

The essential features of this installation are shown in the accompanying diagram. It takes about an hour in the morning to obtain a steam pressure of 80 lb. About 20 kw.-hr. is consumed at a cost of approximately 50 cents.

This installation has been in use for more than a year and is giving excellent satisfaction. W. C. HESTON.

Portland (Ore.) Railway, Light & Power Company.

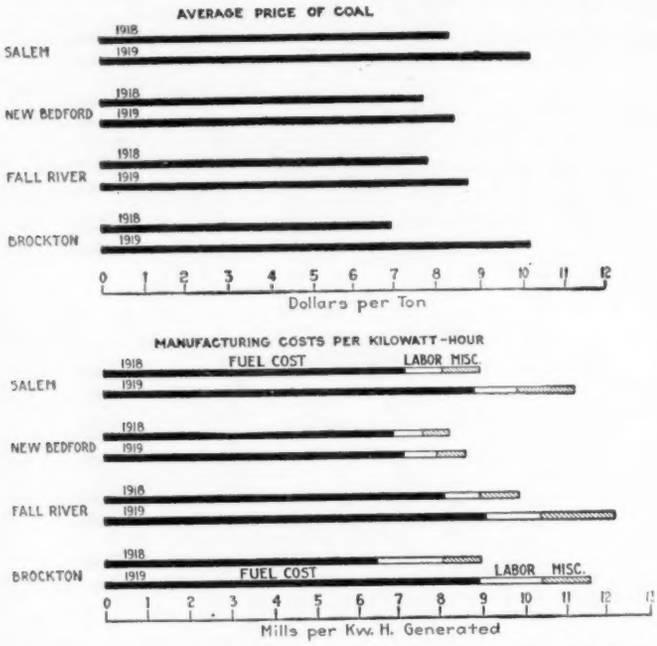
EFFECT OF HIGHER COAL PRICES ON OPERATING COSTS

Only by Increased Production and Efficient Plant Handling Can Burden of Rising Fuel Prices Be Held Within Reason

The advancing price of coal is one of the most serious problems before the central station to-day. That every possible effort must be made to economize in fuel admits of no argument. As operating costs come out the increasing influence of fuel consumption is emphasized. In the ELECTRICAL WORLD of May 17, 1919, page 1009, an analysis of the effect of rising costs upon station production expense was printed. In four of the representative plants quoted the price of coal used ranged in 1918 from $6.91 to $8.25 per ton. Figures are now in hand for the year ended June 30, 1919, and these show that the coal cost per ton in these four stations ranged on the higher plane of $8.39 to $10.23. Fig. 1 shows the advance in coal prices for the individual companies, amounting to from

74 cents to $3.24 in the particular cases, and Fig. 2 shows what this meant in fuel cost per kilowatt-hour generated, as well as the proportion fuel expense to total production cost per unit bears for 1919 and bore in 1918.

This year the total cost per kilowatt-hour in the four stations ranged from about $387,000 to about $675,000,



FIGS. 1 AND 2—AVERAGE PRICE OF COAL AND ANALYSIS OF MANUFACTURING COSTS PER KILOWATT-HOUR IN FOUR CENTRAL STATIONS

and of this outlay from $292,000 to $556,000 represented coal expense and from $38,500 to $63,200 labor cost within the stations. In other words, the total cost of fuel ran sowewhat in excess of eight times the labor expense.

What large-scale output means in the way of reduced station labor expense per unit of output appears from the New Bedford record. This company's growth has been remarkable during the last decade, rising to a total bus delivery of over 78,000,000 kw.-hr. in 1919. With coal at $8.39 per ton, the manufacturing cost was 8.6 mills per kilowatt-hour, fuel cost being 7.1 mills and labor cost 0.8 mill.

All of the four stations increased their generated output during the year, as shown by Table II. The increase in coal costs was so great that in the main these gains in generated output were insufficient to offset the fuel factor, although the station efficiency as expressed in coal consumption per kilowatt-hour was improved in two of the plants and held constant in a third. A summary of the plant operations is given in Table I.

TABLE I—STATION OPERATIONS IN 1919

	Brockton	Fall River	New Bedford	Salem
Ton-hours total manufacturing cost	$400,083	$387,488	$674,720	$416,334
Manufacturing cost per kw.-hr. generated, cents	1.15	1.21	0.86	1.12
Tons coal used	30,161	33,774	66,349	31,843
Cost of coal used	$306,187	$292,837	$556,768	$325,881
Average coal cost per ton	10.15	8.70	8.39	10.23
Coal cost per kw.-hr. cents	0.883	0.911	0.71	0.876
Station labor cost, total	$53,506	$40,912	$63,217	$38,571
Station labor cost per kw.-hr., cents	0.154	0 127	0.08	0.104
Maximum yearly load, kw.	10,100	12,300	23,800	12,360
Average twenty-four-hour station load	3960	3660	8950	4230
Generating station load factor, per cent.	39.2	29.7	37.6	34.4
Kw. average load at bus, including purchased energy	3960	4280	8950	4230
Load factor at bus, including purchased energy	39.2	34.8	37.6	34.4
Lb. coal per kw.-hr.	1.94	2.35	1.895	1.92
STATION OPERATIONS IN 1918				
Manufacturing cost per kw.-hr. generated, cents	0.897	0.983	0.824	0.899
Coal cost per kw.-hr. generated, cents	0.650	0.801	0.685	0.711
Labor cost per kw.-hr. generated, cents	0.519	0.094	0.080	0.096
Price of coal per ton	$6.91	$7.76	$7.65	$8.25
Lb. coal per kw.-hr. generated	2.10	2.31	.201	1.92

TABLE II—KILOWATT-HOURS GENERATED*

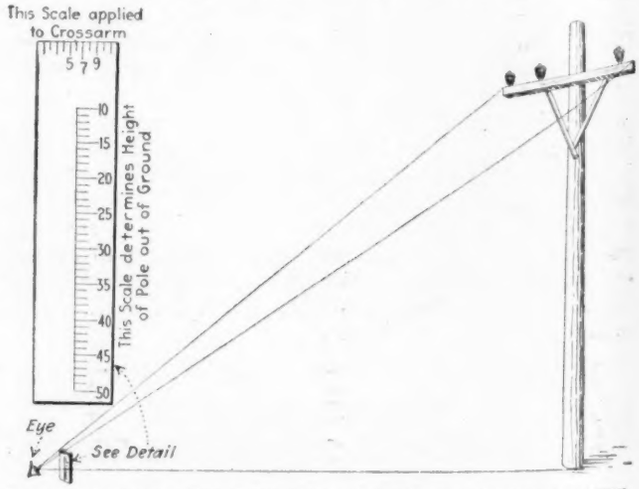
	1918	1919
Brockton	30,286,260	34,748,750
Fall River	31,529,200	32,090,300
New Bedford	62,831,921	78,458,200
Salem	33,103,670	37,116,830

* Not including energy purchased.

LINE-POLE HEIGHT EASILY FOUND WITH SIMPLE DEVICE

Consists of a Celluloid Scale Held Between the Eye and the Pole—Is Particularly Useful for Inventory Purposes

For determining the height of a power-line pole for inventory purposes, the writer developed a device which consists merely of a transparent celluloid scale about 0.05 in. (1.3 mm.) in thickness. It has two scales of the same order, one across the end and one down the center of the piece. The device is held between the eye and the pole which is to be measured, with the cross-scale parallel to the cross-arm and the vertical scale parallel to the pole, and at such a distance from the eye that the divisions on the cross-scale correspond with the length of the cross-arm in feet. (This value is standard and therefore known.) Then the length of the scale which corresponds with the pole will indicate the height of the pole from the ground. Adding the setting depth gives the total length of the pole.



SCALE IS HELD BETWEEN EYE AND POLE TO GIVE LENGTH OF POLE WHEN CROSS-ARM LENGTH IS KNOWN.

SIDNEY B. SHAW.
San Francisco Pacific Gas & Electric Company.

WELL-ARRANGED CONDENSING WATER-PUMPING PLANT

Reinforced-Concrete Well Installation Provides Reliable Service Through Wide Tidal Range at Connecticut Station

At the generating plant of the Stamford (Conn.) Gas & Electric Company on Long Island Sound the maximum range between high and low tide is about 13.5 ft. (4 m.), this extreme variation being caused by the effect of a combination of moon and wind. To insure an adequate supply of condensing water under such conditions, an installation of concrete suction wells shown in cross-section in Fig. 1 is in servece.

To handle the condensing water for 12,750 kw. in turbine units three 20-in. (50-cm.) centrifugal pumps were installed at the bottom of the well structure. They were built by the Wheeler Condenser & Engineering Company and designed to deliver 10,000 gal. (37,800 l.) per minute against a 35-ft. (10.6-m.) head. Each pump is directly driven through a vertical shaft by a 100-hp., 2200-volt General Electric squirrel-cage induction motor mounted on a cast-iron base at the top of the well. The motors are started and stopped from the generating station, which is about 150 ft. (46 m.) inland from the pumping installation.

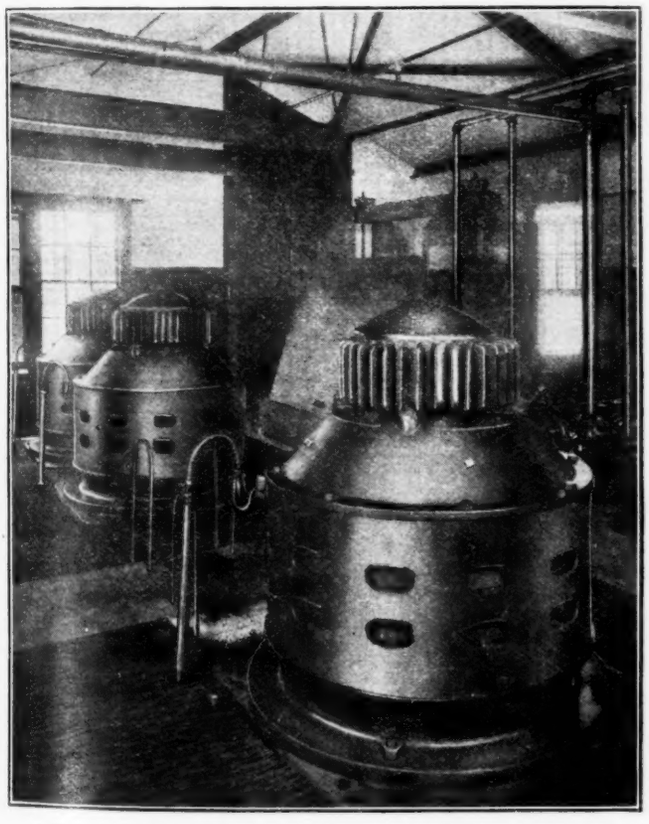


FIG 1—100-HP. SQUIRREL-CAGE INDUCTION MOTORS WHICH DRIVE PUMP TROUGH VERTICAL SHAFT

Two wells have been provided, with a space for an ultimate installation of four pumping units. Each well weighs about 300,000 lb. (136,000 kg.) and was formed and poured on the dock adjacent to the generating station. Then it was lowered into its final site, which had previously been excavated by divers. The pouring of the concrete for the two wells required eighty-four hours. The excavations for the reception of the wells measured about 30 ft. long by 21 ft. wide over all inside and 25 ft. deep (98 m. by 69 m. by 82 m.).

Each well is divided by a reinforced-concrete wall 15 in. (38 cm.) thick into a front section used as a screening chamber and a rear section housing the pump and discharge piping. The outer walls are 12 in. to 14 in. (30 cm. to 36 cm.) thick. The screening chambers are equipped with two traveling screens built by the Chain Belt Company, the screens being installed in sections 60 in. (1.5 m.) long by 18 in. (0.45 m.) wide and provided with small troughs on the bottom designed to hold fish, dirt, leaves, etc., caught by the copper mesh mounted between the buckets. At the top of the well the screen is met by a water jet, which strikes it on the back, washing off debris into a gutter provided for this purpose, and from which refuse can be easily cleared. Each screen is driven through a Poole reduction gear by a 5-hp., 220-volt General Electric motor. The spray piping is provided with ⅛-in. (3-mm.) holes spaced 1 in. (2.5 cm.) apart, and the water for cleaning is delivered to the piping at a pressure of 30 lb. (2.1 kg. per sq cm.) by an installation of two 10-hp., 220-volt Western Electric induction motors directly connected to the pumps.

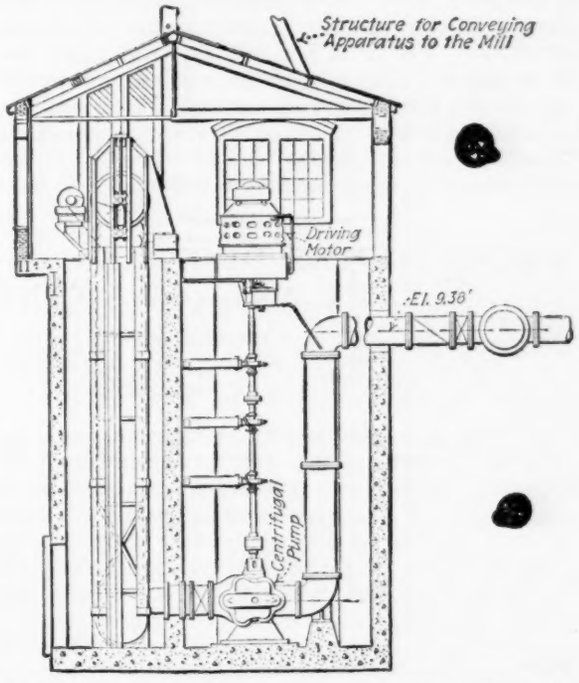


FIG 2—CROSS-SECTION VIEW OF WELL FOR PUMPING CONDENSING WATER

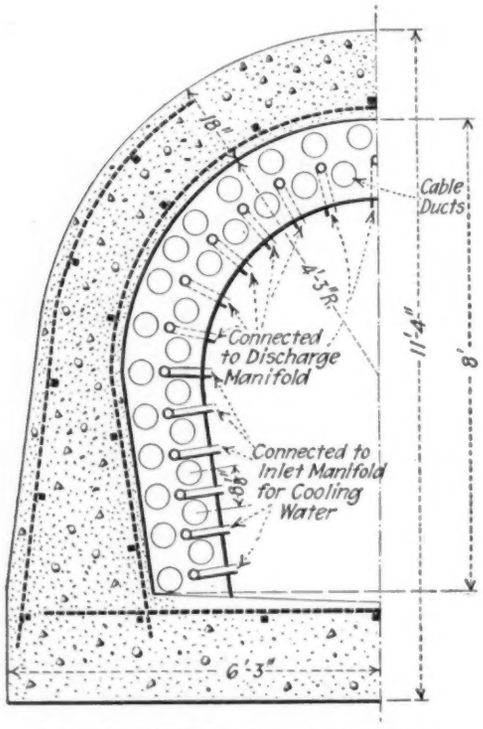
The shafts connecting the main pumps with their driving motors are equipped with self-oiling bearings and with water-cooled thrust bearings. Three 16-in. (40-cm.) discharge pipes are carried upward from the pump casing outlets to a point about 8 ft. (2.4 m.) above mean low water, whence the circulating water is discharged toward the generating plant in three pipe lines consisting of one 24-in. (60-cm.) and two 16-in. (40-cm.) pipes cross-connected by a 30-in. (76-cm.) manifold. Stop and check valves are provided in each discharge line. General Electric auto-starters are provided for the main pump motors.

The motors driving the screens are started on line voltage, while General Electric starting switches mounted in the operating chamber above the pumps are provided for the motors driving the spray pumps. A novel feature of the installation is a hinged trap and folding roof design, which facilitates handling apparatus in the wells. The total cost of the intake wells and equipment, which were completed about two years ago up to three-fourths of the ultimate installation, was about $50,000, or considerably less than an intake and discharge tunnel combination would have cost at the level necessary for continuous service under all tidal variations. George B. Leland, manager of the Stamford Gas & Electric Company, furnished the data from which the above description was prepared.

WATER-COOLED DUCTS IN THE WALL OF A TUNNEL

Water Pipes Laid in Concrete Around the Duct Walls to Prevent Temperature of Cables from Becoming Excessive

In order to cool high-tension cables run through the walls of a tunnel in Cincinnati the Union Gas & Electric Company has installed a system of water pipes which will tend to prevent any excessive cable heating. The cooling system consists of twenty-five 1.5-in. (37-mm.) pipes running parallel to the ducts. At each end of the horizontal section of the tunnel, which is 64 ft. (19 m.) long, the



COOLING SYSTEM FOR CABLE DUCTS

pipes project in to the tunnel chamber and are fitted at their ends with removable plugs. About 7 in. (15 cm.) from the end of each pipe tees are inserted for inlet and outlet connections to manifolds. These manifolds are connected to a gravity or forced-feed circulating system as conditions dictate.

DAILY PLANT REPORT FOR MEDIUM-SIZED STATION

A Complete Report Each Day Enables the Engineer to Analyze the Operation of the Plant and Maintain Its Efficiency

In order that the work around a power plant may be accomplished in a thorough and systematic manner records of some sort are absolutely necessary. Each piece of appar-

COUNTIES GAS AND ELECTRIC CO., NORRISTOWN, PA.
DAILY ELECTRIC PLANT REPORT

Weather { Day / Night

24 Hours Beginning 7 A. M. _____ (Day of Week) 191

UNIT IN SERVICE

BOILERS

No. 1 455 H.P.
No. 2
No. 3 285 H.P.
No. 4—750 H.P.
No. 5—285 H.P.
No. 6—750 H.P.
No. 7—750 H.P.
No. 8—500 H.P.
No. 9—500 H.P.
No. 10—600 H.P.
No. 11—625 H.P.
No. 12—500 H.P.
No. 13—325 H.P.
No. 14—625 H.P.

Hours Run | Date Since Cleaned | Date Last Cleaned | Flue Gas Temp. °F Max. | Min. | Av. | C. O.2 Flue Gas % Max. | Min. | Av.

TURBINE

No. 1—1000 K. W.
No. 2—2500 K. W.
No. 3—2500 K. W.
No. 4—1875 K. W.
No. 5—4000 K. W.

Vacuum Max. | Min. | Av. | Cond. Inlet Temp. °F Max. | Min. | Av. | Cond. Water Disch. Temp. °F Max. | Min. | Av.

ROTARIES

No. 1—300 K. W.
No. 2—300 K. W.
No. 3—200 K. W.

Max. | Min. | Av.

EXCITERS

No. 1
No. 2
No. 3
No. 4

KEY—Solid Line—— Shows Unit in Service. Broken Line - - - - Unit Out of Service. X Indicates Shut Down. Give Reason.

Boiler Feed Water Temperature °F	
Rate of Boiler Feed Mlbs per hour	
Total Boiler Load H. P.	
Boiler Steam Press. lbs. per sq in	
Atmospheric Temperature °F	
St'm Heat Main Press. lbs. per sq in	
Barometer Inches Mercury	
Electrical Peaks { D. C. K. W. / Total K. V. A. / Total K. W.	

Total Coal as Fired	lbs	Moisture %	Total K. W. H. Generated		Load Factor
Total Dry Coal	lbs		Coal per K. W. H.; as fired	lbs	Dry Etc
Total Ash	lbs	%	Coal per K. W. H. for this month to date		lbs
Heating Value of Coal as Fired		B. T. U's	Coal per K. W. H. for this month last year		lbs
Total Water Fed to Boilers		lbs	Water to Boilers per K. W. H		lbs
Total Water Used in Filling, Etc.		lbs	City Water per K. W. H.		lbs
Total Water Used in Blowing		lbs	Boiler Efficiency %		
Total Water Evaporated	lbs	Evap Factor.	Rated Boiler H. P.		
Total Water Evaporated F. and A. 212°F		lbs	Estimated Boiler H. P.		
Evaporation F. and A. 212°F per lb Coal; As fired		Dry	% Rated H. P. Delivered		
City Water for Misc. Purposes	C. F.	lbs			
Total Live Steam to Heating System		lbs			
Equivalent Coal to Heating System		lbs			
Total Steam to Electrical Production		lbs			
Equivalent Coal to Electrical Production		lbs			
Coal Used in Banked Boilers	lbs	%			

FORM OF DAILY PLANT REPORT ADOPTED BY A PENNSYLVANIA CENTRAL STATION

atus should have a definite time when it is to be inspected and repaired if necessary. Then the result of the inspection and kind of repairs needed should be recorded in order that the trouble may be corrected if it happens too often. In addition the manner in which the equipment is operating can be obtained by an analysis of the daily report.

This report when properly filled out gives other data besides recording the time the unit is in service. Some of the items are as follows: Days since cleaned, days run since cleaned, flue-gas temperatures and percentage CO_2, rate of boiler-feed water per hour, electrical peaks, disposition of water, total coal used, coal per kilowatt-hour as compared with previous year, and many other details pertinent to efficient operation.

The above information was given by Henry B. Bryans, engineer of the Counties Gas & Electric Company, Norristown, Pa., before a meeting of the Pennsylvania Electric Association recently.

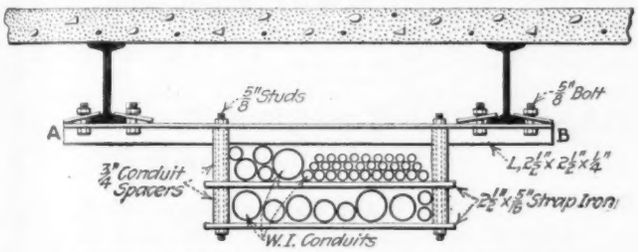
INDUSTRIAL APPLICATIONS

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

MULTIPLE-CONDUIT RUN SUPPORTED ON STEEL RACK

A Number of Different-Size Conduits Can Be Hung on the Same Rack with Minimum Space Requirements and Expense

The construction of a rack for carrying conduits arranged in several layers is shown in the figure. This method has been used in a number of important installations in industrial plants. Only mild-steel members are used so that the rack is absolutely fireproof. While a



METHOD OF HANGING MULTIPLE CONDUIT RUN

2½-in. by 2½-in. by ¼-in. (6-cm. by 6-cm. by 6-mm.) angle is applied for the main supporting member, *AB*, in this instance a lighter or heavier section may be utilized, depending upon the distance between supports and upon the number of conduits in the multiple run. The sizes of the bolts, straps and conduit spacers which are installed are also determined by the size and number of conduits to be supported. Usually it is not desirable to employ any stud or bolt of a diameter smaller than ⅝ in. (15 mm.) because smaller bolts and studs are liable to be twisted in two by the wiremen. GEORGE H. STONE.

MOTOR KEPT IN OPERATION WHILE FUSE IS REPLACED

When Polyphase Motor Is Running Single-Phase Fuse Can Be Changed Without Stopping Motor if Switch Is Thrown Into Starting Position

Excessive heating combined with rumbling sounds in a polyphase motor usually indicates that the machine has blown one fuse and is operating on single phase. After correctly diagnosing the complaint it is often desirable to remedy the trouble without stopping the motor.

This is being done successfully in the mills of a large copper company and no special tools or connectors are required. The procedure is as follows: The electrician throws the motor switch or compensator quickly into the starting position, changes the burned-out fuse and puts the switch back into the running position. Present-day compensators which will not stay in the running position are held there while the fuses are being changed. However, the old-type compensators and double-throw starting switches will stay in any desired position. This scheme is also used with star-delta and other methods of starting where the starting position of the switch is connected ahead of the motor fuses. FRED E. THERREIN.

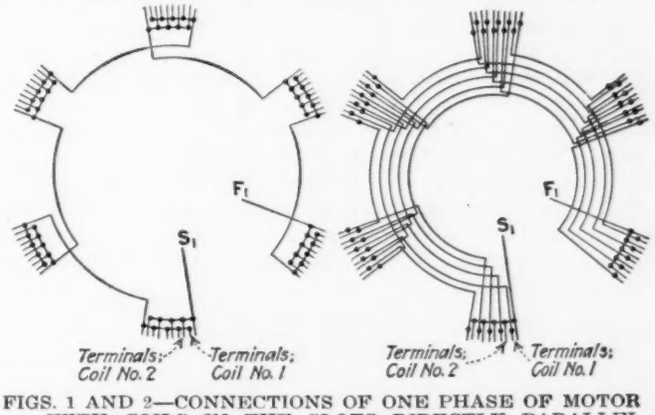
Calumet & Hecla Mining Company,
Lake Linden Mills.

MOTOR OF 1100 VOLTS RATING RECONNECTED FOR 220 VOLTS

Instrument Had Ninety Slots and Six Poles, or Five Slots per Pole per Phase, So that the Coils in the Five Slots Had to Be Paralleled

A change to be made in the generating voltage of the power plant at the Iowa State College at Ames made it necessary to reconnect the windings of an 1100-volt, three-phase, 30-hp., 1120-r.p.m Westinghouse CCL induction motor for 220 volts, or to purchase new windings. If it had had a single-circuit star winding and had been changed to three-parallel delta, it would have become a 212-volt motor and would operate satisfactorily on 220 volts. However, this motor was found to be connected single-circuit delta, so no simple change in the connections would produce the desired result. Since the motor had ninety slots and six poles, or five slots per pole per phase, it was decided to parallel the coils in the five slots to give the required voltage.

In making changes of this kind care had to be taken to see that the voltages of the different paths paralleled were the same not only in numerical value but also in



FIGS. 1 AND 2—CONNECTIONS OF ONE PHASE OF MOTOR WITH COILS IN THE SLOTS DIRECTLY PARALLEL AND CONNECTIONS OF ONE PHASE WITH COILS IN SLOTS BOTH PARALLEL AND IN SERIES WITH COILS 1, 2, 3, 4 AND 5.

phase relation. If the coils in the five slots were directly paralleled, the voltages in the five paths would have the same root-mean-square values but would not have the same values at any given instant and would not have the same phase relations. Fig. 1 shows this scheme of connections for one phase.

The stator windings of an induction motor are the same

in principle as those of an alternator, and the difficulty may be somewhat more easily understood by thinking of the winding as that of an alternator. One pole covers 180 electrical degrees, and in a three-phase machine one phase covers one-third the total, or 60 deg. Considering slots 1 and 5 of the group of five slots in which one of the phases is wound at any pole, even if the voltages were equal they would have a phase difference of 60 deg., and the paralleling of the conductors in these slots would set up a circulating current, exactly as if two alternators were paralleled when their voltages were equal but 60 deg. out of phase. This circulating current would probably overheat the motor.

By properly transposing the connections the circulating current may in some cases be prevented. For example, if the motor in question should have 108 slots, or six slots per pole per phase, the ideal way to connect it as a six-parallel winding would be to put in series in each of the six paths six coils, consisting of conductor No. 1 of the group at the first pole, conductor No. 2 of the group at the second pole, etc. The total voltages generated in each of the six paths would then be identical in value and in phase relation.

In the problem to be solved, with five coils per group and six poles, it was impossible to arrange the end connections for a five-parallel winding in such a way as to obtain a perfect transposition. It was believed that if the ideal transposition was approximated as nearly as possible the circulating current would be so small as to cause no appreciable effect on the temperature of the windings.

The coils were connected as shown in the following table:

	Pole Number					
	1	2	3	4	5	6
	Coil Number					
Path No. 1.....	1	2	3	4	5	6
Path No. 2.....	2	3	4	5	1	1
Path No. 3.....	3	4	5	1	2	2
Path No. 4.....	4	5	1	2	3	3
Path No. 5.....	5	1	2	3	4	4

Each of the five paths in parallel has in series coils bearing numbers 1, 2, 3, 4 and 5 and one other coil. This last coil bears a different number in each of the five paths, which are unlike to this extent. Fig. 2 shows the connections of one phase. The jumpers were arranged so that of the five sets four were alike and the arrangement of those in the fifth set was symmetrical, making it easy to avoid mistakes in reconnecting the windings.

The calculation of the magnitude of the circulating current in this case would be difficult, and this was not attempted; but the motor when tested out in service ran at no load and at full load with no noticeable increase over the normal temperature rise.

H. C. Bartholomew,
Associate Professor Electrical Engineering,
Iowa State College, Ames, Iowa.

SMALL-SCALE AMMETER ELIMINATED TROUBLE

Meter Switch Obviates Possibility of Coil Burning Out During Starting Period Under Rush of Current

When testing an alternating-current motor in a repair shop in New York City it was found that there were only two meters available. One was too large to be of any value for registering the performance of the motor and the other was too small to withstand the initial current rush. Some quick method was therefore necessary to allow the use of the small meter. Shunting the meter with a file during starting nearly caused its destruction, so a single-pole knife switch was inserted as shown in the illustration. While the motor was being started switch No. 1 was closed and switch No. 2 was opened. After

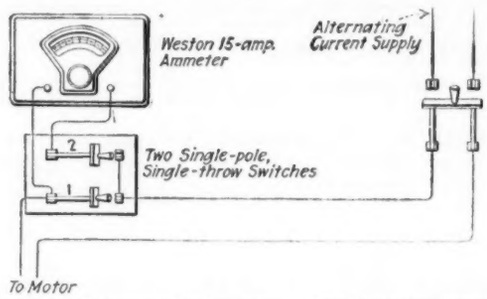


DIAGRAM OF CONNECTIONS FOR AVOIDING DESTRUCTION OF METER DURING STARTING CURRENT

conditions became normal it was an easy matter to close switch No. 2 and then open switch No. 1.

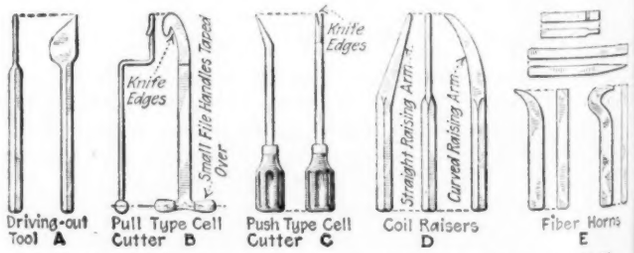
New York, N. Y. Theo. C. Katsigris.

HANDY TOOLS USED FOR REPAIRING ARMATURES

They Are Easily Made in the Shop and Can Be Adapted to Armature Repair Work Found Necessary in Any Plant

Finding it difficult to purchase just the kind of tools they desire, armature repairmen frequently have to make their own. Several of those that have been developed by the writer are illustrated here.

The driving-out tool, marked *A*, is used for driving coil leads out of the commutator bars to which they are soldered, either when stripping the armature or when removing the commutator. It is constructed of either hexagon or octagon tool steel and the blade is forged to the proper thickness. The edges of the blade are ground off on an emery wheel to the desired shape. A complete set of these chisels should consist of four of the following dimensions: One with a ¼-in. (6-mm.) shank and a blade 1/32 in. (0.8 mm.) thick; one with a ¼-in. (6-mm.) shank and a blade 1/16 in. (1.6 mm.) thick; one with a ⅜-in. (9.5-mm.) shank and a blade 3/32 in.



HOMEMADE TOOLS USED IN ARMATURE REPAIR WORK

(2.4 mm.) thick, and one with a ⅜-in. (9.5-mm.) shank and a blade ⅛ in. (3.2 mm.) thick. This tool is only adaptable for use on commutators having solid risers as those having flexible risers will not stand such rough treatment as the former. Coil ends have to be removed from the flexible or more delicate risers by melting the solder.

The letters *B* and *C* in the diagram designate the pull type and push type of cell cutters respectively. The pull-type cell cutter has a hook effect, the inside of the hook having the cutting edges. This type is made of forged steel ⅛ in. (3.2 mm.) thick and ½ in. (13 mm.) wide. To allow free movement of the handle the shank is raised about 2 in. (50 mm.) higher than the blade.

An old screwdriver forms the basis of the push-type cell cutter. It is first ground down to the proper shape, after which the beveled knife edges are filed out with a three-cornered file. The shank is then bent to about a 155 deg. angle at a point 1 in. (25 mm.) from the end.

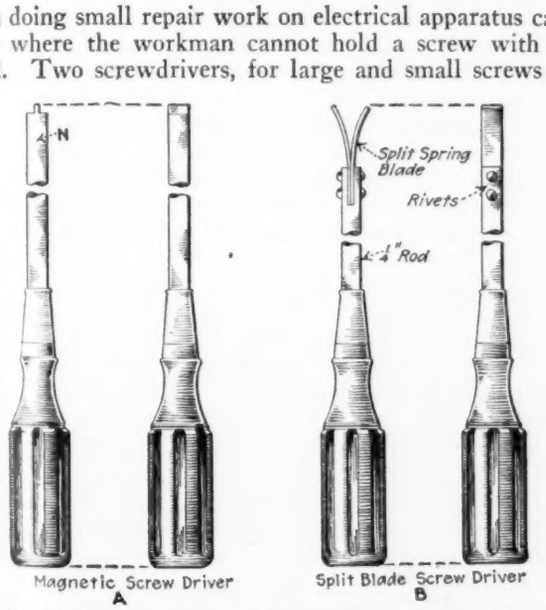
When testing a newly wound open-slot machine, either armature or stator, if one of the coils is grounded in the slot it is necessary to raise the grounded coil without damaging it in order to insulate the exposed parts. For this purpose the coil raiser or stripping piece shown has been designed to take the place of a screwdriver. This tool is constructed of either hexagon or octagon tool steel with a diameter of either ½ in. or ¾ in. (13 mm. or 19 mm.). The service end is ground off smooth.

For all kinds of close shaping work the fiber horns shown in *E* have been found to be valuable. They are useful for shaping the coil ends of armatures and stators. The corners of the horn should be well rounded off to prevent damging either the coils or the worker's hands.

HOME-MADE SCREWDRIVERS FOR SMALL REPAIR WORK

Magnetic and Split-Blade Types Drive Large and Small Screws in Places That Workman Cannot Reach with His Hands

In doing small repair work on electrical apparatus cases arise where the workman cannot hold a screw with his hand. Two screwdrivers, for large and small screws respectively, have been developed for use where this difficulty arises. The former (*A*) has a short shank and is magnetized, and the latter consists of a split-ring blade attached to a ¼-in. (6-mm.) rod. To use the screwdriver two springs are sprung together and inserted in the screw slot. Their tendency to spring outward grips the screw.

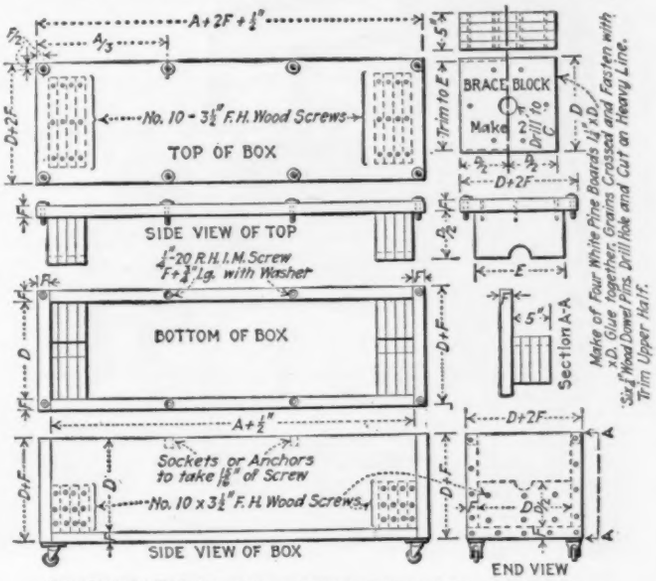


MAGNETIC AND SPLIT-BLADE SCREWDRIVERS

SPARE ARMATURES STORED IN CONTAINING BOXES OF WOOD

These Cases Protect Them from Injury and Make Them Easily Accessible—Standard Specification Covers Design for Any Armature

A spare armature may be in perfect condition when received from the factory, but it cannot always be relied upon for immediate service unless it has been protected from mechanical injury and moisture while in storage.


A+2F+½"
A/3
No. 10 - 3½" F.H. Wood Screws
TOP OF BOX
BRACE BLOCK
Make 2 Drill ⅜"
Trim to E
D+2F
SIDE VIEW OF TOP
¼"-20 R.H.I.M. Screw F+½" Lg. with Washer
BOTTOM OF BOX
Section A-A
A+½"
Sockets or Anchors to take ⅛" of Screw
No. 10 x 3½" F.H. Wood Screws
SIDE VIEW OF BOX
END VIEW
Make of Four White Pine Boards ½" x D. Glue together, Grains Crossed and Fasten with ¾" Wood Dowel Pins. Drill Hole and Cut on Heavy Line. Trim Upper Half.

SPECIFICATIONS FOR BOXES USED FOR STORING SPARE ARMATURES

The meaning of the symbols is as follows: *A* equals over-all length of armature shaft; *B* equals over-all diameter of armature; *C* equals diameter of armature shaft; *D* equals *E* plus ½ in.; *E* equals *B* plus 5 per cent; *F* equals 1½ in. pine boards for armatures which weigh 2400 lb. or less and 2-in. pine boards for heavier armatures; *G* equals Pason casters.

To insure that emergency armatures shall always be ready for use in the event of a breakdown some companies store the spare armatures in individual pine boxes.

Boxes designed especially for this purpose have been built as shown in the illustration and have been found very serviceable. The outside of the box is given two coats of black "Pyro-non" paint and the inside is lined with tar paper.

W. E. WEIGHTMAN,
Chief Engineer Engineering Service Company.
Chicago, Ill.

OIL-SWITCH MOUNTING IN SELF-CONTAINED UNIT

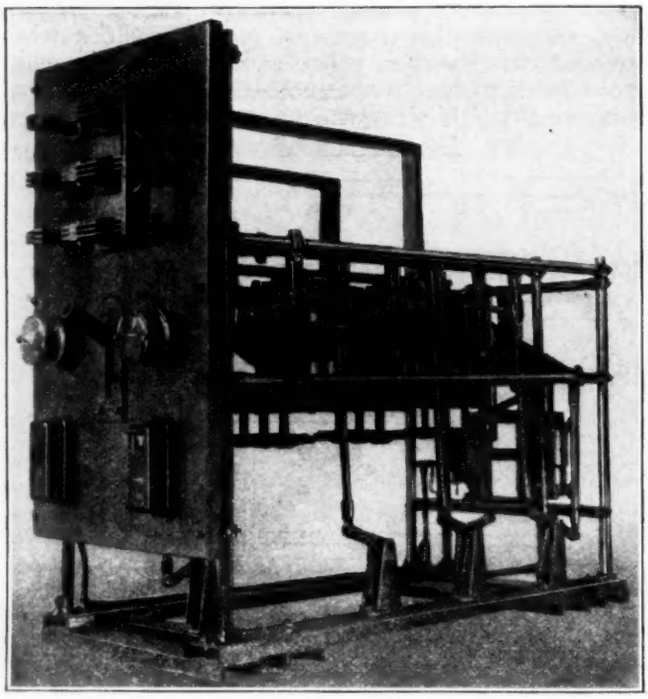
Three-Phase Apparatus Is Mounted on Channel-Iron Frame Which Carries a Panel with Relays and Double-Throw Knife Switch

Any addition to existing power installations in industrial plants often presents serious difficulties due to lack of space and consequent congestion of apparatus. Furthermore, high-tension apparatus is many times placed in compartments which cannot be readily made to accommodate additional or larger equipment. By grouping the apparatus, however, this difficulty may be overcome.

The accompanying ilustration shows the general arrangement of several large oil circuit breakers to be

mounted in the low-tension bus room of a power plant where space is very limited.

The oil circuit breakers, which control 440-volt, three-phase, 60-cycle power feeders, are Westinghouse type F 750-volt, 2000-amp., three-pole switches with overload



THREE-PHASE OIL-SWITCH APPARATUS MOUNTED AS SELF-CONTAINED UNIT IN CHANNEL-IRON FRAME

trip coils operated from current transformers but controlled by Westinghouse type CO overload relays and type BT transfer relays. Each breaker is provided with a 2500-amp., three-pole, double-throw knife switch which allows the use of energy from either the private plant or the central-station bus.

The oil circuit breakers and operating mechanisms, with the panels carrying the knife switches and relays, are mounted on a 1¼-in., (3-cm.) pipe framework with base of 6-in. (15-cm.) channel iron, making a rigid, self-contained and self-supporting unit, approximately 72 in. (1.8 m.) high, 36 in. (1 m.) wide and 84 in. (2.2 m.) deep. The entire unit can be moved without difficulty. The frames, mountings, bus work, etc., were built in the plant with which the writer is connected.

G. S. Van Norman.

Detroit (Mich.) Copper and Brass Rolling Mills.

BALL AND TUBE MILLS DRIVEN THROUGH CHAIN AND GEARS

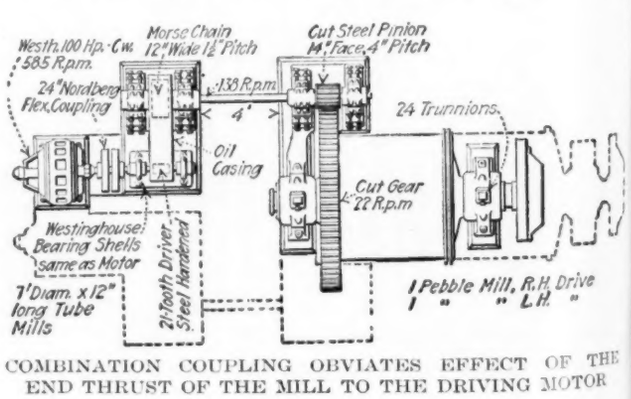
End Thrust of Machines Is So Great that Satisfactory Operation Cannot Be Obtained by Direct or Gear Drive

Because of the end surge present in ball and tube mill operation, satisfactory results cannot usually be obtained with the installation of direct drive or single-reduction gearing. The speed of the driving shaft prevents it from following the jerky surge of the rotating mill and therefore causes excessive side wear on the driving sockets. This difficulty was overcome, however, at the plant of the Rochester (Nev.) Combined Mines Company by the use of flexible shafting, a chain drive and reduction gear as illustrated.

Each unit of the company's plant is composed of one 6-ft. by 4-ft. 6-in. (1.8-m. by 1.4-m.) ball mill and one 7-in. by 12-in. (21-cm. by 30-cm.) tube mill. Excepting for the diameter of the shafts, the driving mechanisms for the two parts of these units are exactly alike to allow them to be interchanged. The Westinghouse motors, which are built on the same frame, thereby making all bearing shells interchangeable, are phase-wound and are designed for good starting characteristics. Each motor is provided with a control panel on which are mounted an ammeter, a primary circuit breaker equipped with overload trip and an under-voltage release, as well as a drum controller behind the board with hand wheel mounted on the face of the panel. By reference to the ammeters the operator knows at all times just what his mills are doing, and he is accordingly able to adjust his ball charge to get the best results. The operating mechanism of the motor-starting controller is interlocked mechanically with the primary circuit breaker so that if the circuit breaker has once tripped it cannot again be closed until the controller has been returned from the "on" to the "off" position.

On each motor shaft is mounted a 24-in. (60-cm.) Nordberg flexible coupling connecting the motor to a short shaft which carries the driving sprocket for the chain drive. This shaft is of the same diameter as the motor shaft and is mounted in two rigid pedestal bearings supplied with ring-oiling removable-bearing sleeves interchangeable with the motor bearings. On this shaft is mounted a driver with twenty-one teeth, which is connected to the sprocket driven by seventy-seven teeth by means of a Morse chain 9 in. (21 cm.) wide. This gives a reduction from 585 r.p.m. to 160 r.p.m. A cut-steel pinion on the opposite end of this driver shaft meshes with the cut gear on the mill so that the speed of the mill will be 24 r.p.m.

By employment of straight-cut spur gears, chain drives, flexible couplings and slip-ring motors a good design is obtained, because any undue strain or surge of the mills which is not absorbed by the straight-cut main gears and is transmitted to the chain sprockets, owing to slightly



COMBINATION COUPLING OBVIATES EFFECT OF THE END THRUST OF THE MILL TO THE DRIVING MOTOR

worn collars on the main shaft, does not affect the running of the chains. This motion is not counteracted by the motor, but is absorbed by the flexible Nordberg coupling connecting the motor with the floating motor extension shaft.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Methods for Increasing the Use of Electric Light, Power and Heat

ATTITUDE OF COMPANY TOWARD INSPECTOR

Percy H. Bartlett Points Out Need for Full Cooperation Between Power Company and Authorities in Charge of Electrical Inspections

The attitude of the power company toward the authorities in charge of electrical inspection was discussed by Percy H. Bartlett, engineer of installations for the Philadelphia Electric Company, before the recent convention of the National Association of Electrical Inspectors at Springfield, Mass.

The necessity for full coöperation with the power company and the same realization by the power company with respect to the inspection authorities is one of the prime requisites in order that both interests may obtain the maximum benefit from inspections. The author cited the methods folowed by one inspection bureau with which he has had experience.

In this bureau, when the inspector visits the risk he fills out a postal card notifying the contractor of the progress of the work, using a code for the purpose of brevity, and a copy of this postal card in blank card form is sent to the power company. "This very frequently gives the power company advance notification of an electrical installation in progress for which no application for electricity has perhaps been made and permits it to follow the matter through to a conclusion," said Mr. Bartlett, "eliminating delays in the final operations necessary to connect the customer to the supply lines.

"This same system is followed throughout the progress of the work until completion, the inspector on the occasion of each visit filling out a card of notification to the contractor detailing by means of the code any defects which require correction, a copy in each case being forwarded to the power company. On the occasion of the final inspection the same method is again followed, the inspector filling out the card notifying the contractor that the temporary certificate of approval has been left at the premises, a copy of the card again being forwarded to the power company. This temporary certificate of approval is left in the main switch box in every instance in order that it may be readily located by the inspector of the power company whose duty it is to introduce the electrical energy. When the permanent certificate is issued a copy of this is sent to the power company, which constitutes its permanent authority for the introduction of energy so far as the Underwriters' Association is concerned."

Mr. Bartlett said that the Underwriters' inspection bureau sends to the power company each year a schedule for the year, which is corrected from time to time as may be necessary, detailing the men on duty on holidays or the men that are available for emergency duty any time of the day or night outside of the regular business hours. This list gives the name of the inspector, home address and telephone number. It is not expected that these men will be called on for routine work, but in case of emergency or breakdown, which will arise more or less frequently, a temporary certificate of approval can always be procured with little trouble.

One of the moves instituted by the management of the Underwriters' inspection bureau assisted by the power company has been the holding during the winter season of a series of what are known as "electrical conferences," to which invitations are sent to the electrical contractors and their employees and others interested in electrical work in general. These conferences, which are very largely attended, aim to reach particularly the smaller contractor and the employees of electrical contractors, who usually have no common meeting ground where they can debate their problems or broaden their experience and viewpoint.

The power company on its part scrupulously carries out its agreement not to permit the introduction of energy on any installation prior to receipt of the certificate of approval of the Underwriters' Association.

MEASURING DEPRECIATION BY THE UNITS PRODUCED

To Figure Depreciation as Proportional to the Business Done Will Often Give the Most Accurate Idea of Conditions

BY "KASSANDRA"

Depreciation is usually spoken of as a per cent per annum and is measured by assigning to the property a life of a given number of years.

There is, however, a method by which some of the problems of depreciation can be more easily handled, and this consists in measuring depreciation, not by the life in years, but by the number of units of business to be done by the piece of property in question. For instance, instead of figuring how many years an automobile would last, we figure how many miles it would be run. A turbine would be figured to turn out so many million kilowatt-hours, and so on.

Take an investment of say $100,000. The life of the property may be estimated at ten years and the scrap value at the end at $25,000. This leaves $75,000 to be earned for depreciation, and on a sinking-fund basis at 6 per cent interest this requires approximately 5.7 per cent to be laid aside out of earnings each year. The balance of the net earnings is available for dividends. This is the ordinary method, and if the amount of business done and the earnings are the same each year there is no difficulty.

Supposce, however, that the investment is of a nature such that the amount of business done will be very small the first years and large in the later years, but the business and the earnings are expected to be such that the total

earnings before the property is discarded will be enough to warrant the investment.

Now, if the depreciation is calculated on the basis of years' life, the accounts would probably show that at first there were small earnings; and if depreciation is charged during these years, the accounts will show that the business was operated at a loss during the early years and then at an excessive profit during the later years. In spite of this the business would have gone on just as had been expected, and at the end of the whole period the owner would have obtained net just what he had figured on, no more and no less.

If, on the other hand, the life had been figured in units of business done, then as the output was small at first, the depreciation charge would likewise have been small at first and but a small tax on the small earning. Toward the end of the period the business done and the depreciation charge would get larger, and finally the total charge to depreciation would equal the amount necessary to replace the property when it became no longer of any use.

An example of the kind where earnings are large at first and small later might be the putting in of a new turbine in an electric generating station. The turbine will last say ten years before it will have to be discarded. During the first part of its life it will be the most efficient unit in the plant and will be used to carry most of the load. Its earnings during the period will be large, while at the end of its life there will probably be still more efficient units installed. Toward the end the turbine will be used for standby only and will turn but few units on which the company can earn.

In businesses subject to public regulation and to limitation of profits, if the depreciation charges are made large and the dividends small during the first year, this involves higher dividends later and may toward the end involve such high dividends that a part of them are confiscated by the public either in the form of taxes or by giving the high earnings to the customers in the form of lower rates.

In the case, therefore, of public utilities it is advantageous to make the dividends uniform during the life of the property, and when the earnings are irregular year by year to let the depreciation charges be high when the earnings are high, and low when the earnings are low.

An ideal way is to charge to depreciation (or appreciation) each year the net difference between the actual net earnings and the reasonable dividend. This seems dangerous, but if the earnings of the whole period and the life of the property turn out to be as estimated, the final result is exactly right, and this method in fact is often used. The books are made up so as to show the dividend just earned, all the rest of the earnings being charged off. Unless the owners waste their dividends this method is no less safe or less accurate than any other. The final result depends on the correctness of the total estimate and not on the amount charged each year.

Necessity of Estimating Property's Life

In the foregoing discussion there has been one essential assumption, to the effect that we estimate what the life of the property will be, measured either in years or in business, and also that we estimate what the earnings will be each year.

It is always necessary to make these estimates, even when we know that there is great risk that the estimates may turn out to be wrong. The estimate that an investment will pay necessarily involves an estimate as to its earnings and its life. The method of estimating the life in units of business rather than in years has the great advantage that it is apt to be more accurate when applied to business problems.

Much modern machinery will last forever if kept in condition. It would, however, be very unbusinesslike to estimate a perpetual life and to make no depreciation charge: it is better to estimate that the particular piece of machinery, as a turbine, can be made to turn out so many kilowatt-hours before it is superseded by a more efficient one. If, on the other hand, the life is estimated in years and depreciation charged purely on the basis of estimates of the physical life of the property, then the owner is apt to find on his hands a lot of perfectly good machines which he carries on his books at a high value but which will earn him no money.

However, the question of physical life must not be lost sight of. For instance, a cab company may charge so much per cab mile to depreciation, but if it has any horses it must remember that they will grow old and depreciate even while standing idle.

The exact method to be followed in any business or by any particular company is a matter of judgment. It may be per car mile, or per kilowatt-hour, or per dollar of gross earnings, or of net earnings, or of net earnings above a reasonable dividend. The essential point is that total charges to depreciation should be enough to repay the investment when it ceases to earn.

HIGH COST OF SERVING AGRICULTURAL CUSTOMERS

Experience of South Bend Company Shows Fixed Charge and Losses Are $2.09 per Month per Customer Without Station Costs

At every central-station meeting in the Middle West delegates discuss the good and bad points of farm service. In nearly every case some one produces data to show that serving the farmer is unprofitable. Such an incident happened at the recent convention of the Indiana Electric Light Association, when F. A. Bryan, president and general manager Indiana & Michigan Electric Company, gave the following data upon a farm line which his company had built. The data were prepared on the basis of eight customers per mile of line in order to arrive at a unit figure giving costs per customer and per mile. While eight customers to the mile is correct for conditions in the territory served around South Bend, this is of course higher than the average:

If it is assumed that a fair demand charge is $16 per kilowatt, and if an energy production charge of 1.5 cents is assumed, then the cost of energy would be 6 cents per kilowatt-hour. Then the customer who uses 15 kw.-hr. per month should pay fifteen times 6 cents for the electricity, plus $2.09 for fixed distribution charges and losses, plus 5 cents for other expenses, including meter reading, billing, interest and depreciation on plant, etc., or a total of $3.50 per month. This is the equivalent of 23 cents per kilowatt-hour.

Such a kilowatt-hour charge is generally thought to be not in accord with good public and commercial policy,

DATA ON AGRICULTURAL SERVICE IN INDIANA

Investment in rural lines per mile on a basis of service to eight customers:	
Cost of distribution line	$800.00
Cost of service transformers:	
Two 1-kw. transformers at $35 each (four customers)	70.00
Four ½-kw. transformers at $24 each (four customers)	96.00
Cost of secondaries and service extensions	330.00
Cost of meters, eight at $8	64.00
Total	$1,360.00
Average investment per customer	$170.00
Fixed charges—cost:	
Interest, 8 per cent.	
Depreciation and maintenance, 5 per cent.	
Taxes, 1.5 per cent.	
Total fixed charges per customer per year at 14½ per cent	$22.95

LOSSES

	Watts per hr. per mile
Transformer losses (core losses):	
½-kw. transformer, 16 watts × 4	64
1-kw. transformer, 21 watts × 2	42
Meter loss, 1 watt × 8	8
Total core loss	114
	Kw.-hr.
Total core loss per year per mile =	985
Copper loss, 5 per cent of energy consumed on a basis of 180 kw.-hr. per year per customer = 1440 kw.-hr. per eight customers	72
Line loss, 5 per cent of 1440 (180 × 8) per mile	72
Total losses for eight customers or one mile	1129
Loss per customer	141
At 1.5 cents per kw.-hr. per customer yer year, $2.11	
Total distributing losses per year per customer	$2.11
Fixed charges	22.95
Total cost outside of station per customer per year	$25.06
Fixed charges plus losses per customer per month	$2.09

and the usual solution is to incorporate a sufficiently high minimum charge or service charge into the rate to make the business profitable.

DETROIT COMPANY'S POLICY ON SALES OF MERCHANDISE

Methods So Calculated as Not to Encroach on Fields of Dealers and Also to Insure Steady Growth of Appliance Sales and Load

BY A. H. TOUSCANY*
Detroit Edison Company

The Detroit Edison Company sells only lamp-socket heating devices such as irons, toasters, percolators, etc., while the marketing of the large devices is left entirely with electrical merchants, department stores and hardware dealers. We stand ready at all times to give these concerns our coöperation and help. We do not compete with them in any way, and they have a clear field so far as we are concerned. There is a healthy spirit of competition among them which is the life of their business.

There is an agency for each washer and cleaner of any merit that is being manufactured, and they are all doing a substantial business. About 250 stores in the city of Detroit sell electrical appliances. These dealers have nothing to fear from the central station. We are absolutely impartial. With us it is a case of the device with the most merit winning out. Many customers seeking information ask us which make of a certain appliance they should buy. We do not believe it proper that we should appoint ourselves as judges and attempt to favor a few manufacturers and discriminate against others. Of course, if we find that a certain device is causing serious trouble or if we know of a dealer not giving reasonable service on the appliance he sells, we do not hesitate to tell the prospective purchaser asking our advice what we know about these things.

The one appliance which perhaps the Edison company will always keep for its own is the lowly flatiron. If marketing this device were left entirely to the dealers, they would no doubt in their eagerness to sell forget that the heart of the device is the heating element, and they would purchase cheap irons. Some of them would not know that it is not always the iron with the highest polish that does the best work. We have noticed that some of our department stores and dealers have a tendency to handle the cheaper lines of small appliances, and we have every reason to believe that if the heating-device business were left entirely to them our lines would be flooded with low-priced appliances of inferior makes which would cause considerable trouble.

In the small towns outside Detroit known as the eastern Michigan division little or no attention is paid to the development of the electrical appliance business by the local merchants. We feel it is our duty to the public to have an adequate stock of all the labor-saving devices on display for its convenience and inspection, and although we are handling a complete line of electrical appliances at all of our outside display rooms, we are not trying to build up an electric appliance business in our territories.

Eventually we expect to convince every druggist in our towns that he should sell electric heating pads as well as hot-water bottles. We wish to convince the hardware dealer that he should not only sell electric washers, cleaners and ranges in preference to the old-style devices but that he should stock them in reasonable quantities and give them the proper display space and the attention they deserve. Dealers in the small towns must be taught that they cannot sell a washer or a cleaner as they can a pound of nails. They must be made to understand that with the profits they must take the responsibility of the sale, that service is of paramount importance and is absolutely an essential factor in the appliance business.

In our eastern Michigan division, in which we have thirty display rooms, we are endeavoring to market electrical appliances in much the same way as a hardware dealer sells his goods. We are trying to teach our customers through window displays, newspaper advertising and store demonstrations the uses and advantages of electric appliances. We want to educate them to buy these utilities in much the same way as they buy commodities from their hardware and furniture dealers. We have no solicitors—in fact, we feel that we should not annoy our customers by constant solicitation, but we should educate them to the use of these devices through other mediums. We want a safe, healthy increase in our merchandise business from month to month and year to year, and we feel that a safe and sane way of getting it is by the department-store method.

By pursuing this policy our merchandise business in the eastern Michigan division is steadily increasing. Our merchandise sales for 1917 showed a 50 per cent increase over 1916. We did 85 per cent more business in 1918 than in 1917, and for the first six months of this year we have had a 148 per cent increase over the first six months of last year.

We coöoperate with and extend the helping hand to all legitimate dealers in things electrical. The free service that we give is not limited to appliances sold by us. It extends also to devices sold by dealers. We sell every-

*From a paper presented before the Michigan Section National Electric Light Association.

thing, including ranges, at manufacturers' list prices, and we do not pay commissions or bonuses nor do we do free wiring. We do not advertise any particular manufacturer's product. Although we prefer nationally advertised appliances, we do not object to new lines of devices being put on the market. We send our advertising matter with our monthly bills, but our name does not appear on the advertisements. Some one gets the benefit of this advertising.

Special attention is paid to store arrangements, and our store displays are so arranged that a customer in paying a monthly bill walks through our entire display. All of the small heating devices are kept in glass showcases. This not only adds materially to the appearance of the store but allows us to keep a sample of each device on display constantly without its losing value. Washing machines and ranges are connected so that customers can see devices in action.

While we offer no bonuses or commissions to our salespeople in the sale of appliances, we recognize that there should be some incentive offered, so we issue a comparative appliance sales report each month. Because of the close attention that is paid to this report by various officers of the company, and because our district agents are vitally interested, each local agent is very anxious to make a good showing for his community.

THE COST OF PREPARING PULVERIZED COAL FOR FUEL*

Data on This Subject as Applied to Blast Furnaces Should Be of Use to Central-Station and Industrial-Plant Engineers

The data presented below were prepared by E. P. Mathewson and W. L. Wotherspoon in connection with the investigation of the use of pulverized coal for blast furnaces, but the cost of preparation is one of importance in steam-raising plants as well.

The cost of preparing pulverized coal will vary considerably, as there are several factors bearing on the matter, among which are labor, power, fuel for drier and repairs, in addition to interest and depreciation on buildings and equipment. The energy required for crushing, drying, elevating and conveying the pulverized coal will be about 20 hp.-hr. per ton of coal handled, and with modern equipment under average conditions the cost will be approximately 8 cents per ton per hour.

At the International Nickel Company's smeltery the average cost of preparing and delivering the coal to the furnace, in 1913, was as follows: Labor, $0.15; energy, $0.10; repairs, $0.145; coal for drying, $0.055.

*Excerpted from an article in the July, 1919, issue of the *Bulletin* of the Canadian Mining Institute.

HANDLING COMPLAINTS: A STORY OF THE "DEADLY PARALLEL"

Taking as his subject "The Smiling Complaint Man," J. Prince Webster, formerly a member of the Georgia Railroad Commission, talked before the recent convention of the Southeastern Section of the National Electric Light Association at Asheville, N. C. He threw into sharp contrast the methods of two companies in handling complaints from the public. Here are the two policies, with weakness and strength revealed clearly:

COMPANY A

A complainant walks into the office and states that his bill for the past month is incorrect, that he could not have possibly used so much electricity; it is all out of line with what his bill was the past month and for the same month the preceding year, and he feels that some error has been made and wants it corrected. After being shunted from one window to another, his feelings all the time getting more and more wounded at being compelled to do the errand work for the company in the handling of what in his mind is an error on the part of the company, he finally reaches the man supposed to handle the complaint. He is met with this attitude: "Well, our books show that the meter readings are as shown on the bill; our books are honestly and correctly kept; our meters are mechanically accurate, and so you must have used the electrical energy, and if you cannot show the company wherein the company is wrong, I'm sorry but we can't do anything for you." If the complainant gets mad and states that he will not pay the bill as rendered, he is then politely told that if the bill is not paid by a certain day the service will be discontinued. The complainant has no other place to go (the company being a monopoly, and properly so), and not wanting to lose the service, which is a necessity, under protest, feeling that his complaint has not been fairly and sympathetically treated, he pays the bill as rendered, but—and mind you this is the point—he goes back to his neighbors and states that the company has robbed him; and as a self-appointed missionary in such work he never loses an opportunity to tell of the injustice that the company has done him, and besides he will never again believe anything good of the company, and when the time comes for the company to have the support of the people, either in strike situations or rate increase petitions, this complainant, nursing his grievance, tries to get even.

COMPANY B

A complainant comes, in and the desk of the smiling complaint man is where he can see it without difficulty. It is not necessary for him to ask questions as to whom he wants to see to register a complaint. He walks up to the complaint man and states that he has a complaint against the company; the smiling complaint man asks him to have a seat and tries to make him feel at home. He tells him from the start that the company appreciates his call and is glad to get his complaint, for only in this way can the company know whether or not its services are satisfactory. The complainant then tells his story—that his bill is wrong, etc. The smiling complaint man agrees with him that the bill does look large, that there may be some error in it; that he will be more than glad to investigate the complaint fully (the smiling complaint man does all the errand work in so far as the complainant is concerned), and he will be glad to call at his place of business the following day and give him the result of his investigation of the complaint—and, what is more, tells the complainant that the company is a public servant trying to serve; that errors do creep in at times and always will so long as human agencies must necessarily do part of the work, but, realizing that the complainant should have a complete statement of the company's position in the matter, he will give it to him, and then, after the complainant sees all the cards on the table, the company will let him, the complainant, decide as to what is right in the matter.

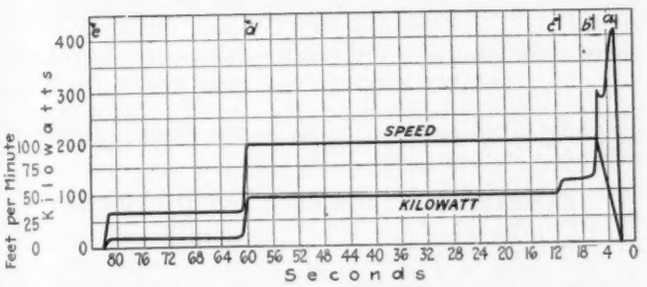
If the public service company's position or contention is correct, nine times out of ten the complainant will agree with the company and will be glad to dispose of the complaint on basis of the company's contention, feeling satisfied that his complaint has been fairly and fully investigated and a just conclusion reached.

DIGEST OF ELECTRICAL LITERATURE

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

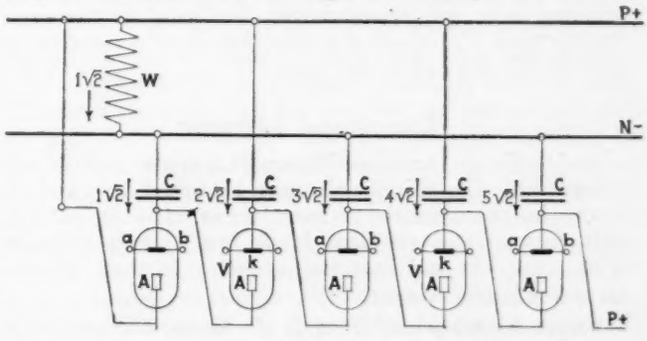
Induction Motor Drive for Skip Hoists.—F. R. BURT.—It has recently been shown that the alternating-current motor is suitable for skip-hoist service—a field formerly exclusively covered by direct-current equipment. The requirements in this service are safety, high starting torque, positive slow-down and accurate stop and continuity of service. These requirements are satisfactorily met by an



GRAPHIC RECORD OF LOAD AND SPEED WHEN HOISTING A FULL BUCKET

alternating-current induction motor having a two-speed winding. The author states that a motor of this type gives better operation on slow speed than does a direct-current machine, since the speed is more uniform under varying loads. A hoist driven by a motor of this type has recently been put into operation at the sintering plant of one of the larger steel companies. The hoist is used to elevate the flue dust to the upper bunkers and is a vertical, double-balanced skip, the height being 105 ft. (32 m.). Each bucket weighs 9,000 lb. (2,700 kg.) and carries a net load of 24,000 lb. (7,300 kg.) of flue dust. It is driven by a 125-40 hp., three-phase, 25-cycle, 220-volt, two-speed, wound-rotor induction motor for six and eighteen poles. The full-load speed on the high-speed winding is 480 r.p.m. and on the low-speed winding 160 r.p.m. When the operator moves the master switch to the forward or reverse position the proper directional switch closes, the brake is released, and the motor accelerates on the high-speed winding. When the bucket reaches the knuckle at the top of the track, the geared limit switch opens one contact and closes another, which transfers the power from the six-pole winding to the eighteen-pole winding, and the rope speed slows down from 100 ft. (30.4 m.) a minute to 33 ft. per minute. When the dumping position is reached another contact on the limit switch opens the control circuit, cutting the motor off the line and applying the brake.—*Electric Journal,* September, 1919.

Generation of High-Tension Direct Current.—M. SCHENKEL.—A new method is described by which high direct-current voltages may be obtained by using alternating voltages of moderate values. In the figure *W* represents the alternator winding, *C* condensers, *V* vacuum valves with anodes *A* and hot cathodes *K* heated by cells applied at *ab*. Considering the first circuit, *CV*, the condenser will be charged up to the maximum value, or $\sqrt{2}$ of the alternator voltage during the first half period. During the second half period the condenser is prevented from discharging by the valve and, the alternator voltage being reversed, a voltage of $2.\sqrt{2}$ will be reached between the valve terminals. It will be seen that this voltage is applied to the next condenser valve circuit, and so on, so that the voltage across successive valves will be $2.\sqrt{2}$, $3.\sqrt{2}$, $4.\sqrt{2}$, and so on. In this manner the voltage may be raised to the limit set by the insulation of the system. If current is taken from the last condenser, it is immediately recharged from the winding *W*. As this takes place with the aid of the preceding condensers, these must differ in size, so as to decrease in size with increasing voltage. Thus, the first condenser, which has the same voltage as *W*, will be the largest. The magnitude of the current that can be delivered by this apparatus is generally small and is limited by the size of condensers. Mechanical rectifying commutators, or other types of electric valves, may be substituted for the hot-cathode valves. Overloading above the saturation current of the valves is impossible, and when out of use repairs may be effected without danger of shocks, which is one



ARRANGEMENT FOR PRODUCING HIGH-TENSION DIRECT CURRENT.

of the advantages as compared to a battery of cells.—*Technical Review,* Sept. 16, 1919. (Abstracted from *Elektrot. Zeits.,* July 10, 1919.)

A New Form of Tank for Static Transformers.—W. S. MOODY.—The author states that entrapped moisture is probably the greatest deleterious agent affecting high-grade insulation. This is particularly important in the case of transformer oil, in which a comparatively insignificant quantity of water seriously lowers the insulating properties of the oil. The most completely effective method of accomplishing this protection against moisture in transformers is to have the tank cover and terminals air-tight. This requires not only an expensive tank construction but also a large air-filled idle space above the oil level to limit the possible internal pressure due to the expansion of

the oil resulting from increase in temperature. Owing to chemical action within the transformer combustible gases are sometimes developed which may be ignited by sparks occurring along the leads. Hot oil slowly decomposes when in contact with oxygen, and a precipitate or sludge is thrown down. The settlement of this sludge on core surfaces and in the ducts may seriously affect the temperature of the oil in the transformer. Investigation has demonstrated that when air is not present the oil can be operated continuously at a temperature that would prove disastrous if air were present, with practically no sludge resulting. The author names the following possibilities for improving transformer construction: (1) An immediate indication of the oil-tightness of all joints, thus insuring absolute protection against the entrance of moisture; (2) the elimination of all air space between the cover and the oil level; (3) the reduction in the amount and temperature of the oil in contact with the air. The conservator type of transformer tank, developed to meet these possible improvements, consists of an auxiliary tank connected to the top of the main transformer tank by a suitable pipe mounted somewhere above the level of the oil in the main transformer tank. When the auxiliary tank is supplied with oil the main tank and connecting tanks are completely filled, and the only oil that comes in contact with the air is that in the conservator. This is shown diagrammatically in the illustration. Transformer oil increases in volume about 4 per cent with a temperature rise of 50 deg. C., and this with other necessary allowances brings the volume of the auxiliary conservator tank to about 8 per cent of that of the main tank. It is said that this design results in a reduction in the necessary size of the tanks and consequently of bushings and that explosive gases cannot be developed in the transformer case since the only oil exposed to the air in the conservator is at low temperature. Sludging in the transformer tank is eliminated by the absence of air.—*General Electric Review,* October, 1919.

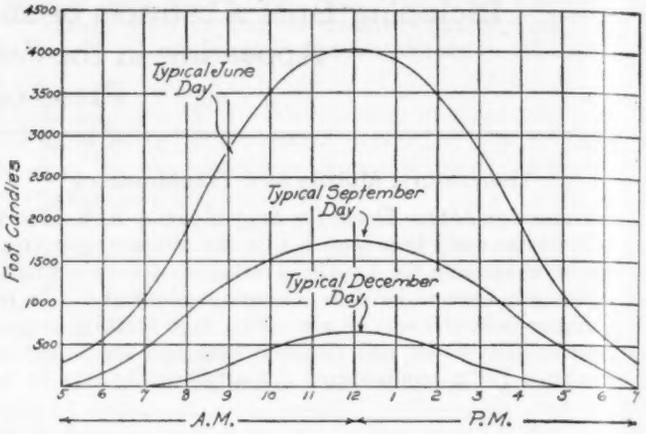
Lamps and Lighting

Industrial Lighting.—Ward Harrison and H. H. Magdsick.—In this article may be found an extensive comparison between the performance of 110-volt and 220-volt vacuum and gas-filled lamps and also data dealing with costs, life and operating economy of these units.—*Central Station,* August, 1919.

Street Lighting and Traffic Accidents.—Ward Harrison.—In this article the writer gives an analysis of a year's traffic accidents in the city of Cleveland, showing the time of day and season. It is interesting to note that a large portion of these accidents were due to a lack of light. It is shown that where effective street illumination is used there is a marked tendency for accidents to decrease.—*Electrical Review,* Oct. 11, 1919.

Lighting of Factories and Mercantile Establishments.—In this publication, known as Bulletin No. 18, New York Industrial Code, are given the minimum foot-candle requirements for factories and mercantile establishments in the State of New York.—Department of Labor, State Industrial Commission, July 1, 1919.

Industrial Lighting.—C. E. Clewell.—This is a rather complete statement of the development of illumination engineering with reference to industrial plants at the present time. Among the interesting charts submitted by the author, one is reproduced herewith showing the variation of daylight illumination in a plant for typical days in June, September and December, indicating the increased



DECEMBER SHOWS 15 PER CENT OF JUNE MAXIMUM AND GREATLY REDUCED DAYLIGHT HOURS

artificial illumination required in the winter.—*Journal Franklin Institute,* July, 1919.

Generation, Transmission and Distribution

The West Penn System.—In this article may be found a description of the system of electric railways, light and power serving a territory of 2500 sq. miles (6470 sq. km.) in the vicinity of Pittsburgh. A new plant with alternate capacity of 300,000 kw. and to cost $5,000,000 is now under construction at Springdale, Pa., on the Allegheny River. The intake is designed to handle the entire low-water flow of the Allegheny River, or approximately 1000 cu. ft. (28 cu. m.) a second. The first installation is to consist of two 25,000-kva. Westinghouse steam turbines and six 1529-hp. boilers operating at 350 lb. (25 kg.) drum pressure. It is the plan to operate the boilers continuously at 450 per cent rating, with good grade of coal to produce from 180,000 lb. to 200,000 lb. (80,000 kg. to 90,000 kg.) of steam per hour. All auxiliaries with the exception of one exciter and one boiler-feed pump are motor-driven, the energy for the auxiliaries being obtained from a non-condensing house turbine of 2500 kva. capacity or through step-down transformers from the main generator bus. The exhaust steam from the house turbine will be used to heat the feed water to approximately 210 deg. Fahr. At first economizers will not be installed, but provision is made for their use in the station. It is expected that the Springdale station will be in operation in March, 1920.—*Electric Traction,* September, 1919.

National Water-Power Conservation.—Thomas J. Royer.—A general discussion of the water-power problem with reference to the potential water power in different sections of the United States and that already developed. The author points out the need of nation-wide development to conserve coal and other fuels.—*National Engineer,* October, 1919.

Calculating Transmission Lines.—B. Guerschinovitch.—In the *Revue Générale* for April 7, 1917, and Nov. 10, 1917, the first and second parts of this article appeared, dealing with the practical calculation of electrical transmission from the point of view of economy. In the third part the author gives the calculation of a

complete network, basing his conclusions upon the result obtained in the previous installments.—*Revue Générale de l'Electricité,* Sept. 27, 1919.

Theory of Frequency Doublers.—M. OSNOS.—Discusses the operation of frequency doublers in which use is made of two transformers, and shows how the operation can be deduced from consideration of a single transformer. —*Science Abstracts, Section B,* July 31, 1919. (Abstracted from *Electrot u. Maschinenbau,* Feb. 2, 1919.)

Induction and Capacity of Transmission Line.—FISCHER-HINNEN.—In the concluding part of this article formulas giving line capacity are based in part on the analogy between capacity and conductance. Regarding single-phase lines, it is pointed out that a conductor may attain a dangerous voltage above ground even though it is not tied in with any energizing line. Three elaborate tables are printed permitting the rapid determination of the self-induction and capacity of single-phase, two-phase and three-phase lines with the arrangement of conductors most frequently used.—*Revue Générale de l'Electricité,* Aug. 23, 1919.

Large High-Tension Alternating-Current Stations and Networks.—A. HAVEY.—An elaborately illustrated article covering the different points of view and opinions of technical men upon the proper characteristics of large installations and indicating the principles, methods and general rules that should govern their establishment. In addition, the author has sought, in the absence of an official terminology and classification, to work out one which could serve as a basis in the future.—*Revue Générale de l'Electricité,* Aug. 30, Sept. 6 and Sept. 13, 1919.

The Lake Welchen (Bavaria) Central Station and the Bavarian 100,000-Volt Electric Network.—The hydroelectric distribution station, which was commenced at the end of 1918, is intended to feed a vast distributing network connecting up the principal towns in Bavaria. With this system will be connected various existing steam stations. The Lake Welchen station is fed by a branch of the Istar River, led by a tunnel to the lake, which serves as a control reservoir. The water is taken thence, by a tunnel over the greater part, and brought to a reservoir on the slope of Mount Kessel, whence depart six high-pressure pipe lines, 2 m. in diameter and of 200 m. head, which lead to the station proper on the edge of the Kochel lake. The network will extend over 400 km. from the station, and the primary system decided upon is three-phase at 100,000 volts. Each turbo-alternator group, of about 24,000 hp. or 18,000 kw., is connected up to a transformer forming part of the set but placed in a large building parallel to the turbine room. The connection between these two buildings is formed by a tunnel in which are placed the primary cables. The 100,000-volt overhead cables are of aluminum of 120 sq. mm. cross-sectional area. They are suspended by insulators to steel towers 25 m. high. The principal substations will be installed in a dozen towns and will supply secondary current at a pressure of 25 kv. or 50 kv., which will be distributed to networks. These in their turn will have small substations for transforming the tertiary current into the ordinary voltages of distribution. The Lake Welchen station will be connected up with a number of other hydroelectric stations already in operation on the Istar, the Lech, etc., which will continue supplying their own networks and will draw the surplus power they require from the Welchen station or give up any excess due to the slack seasons to the Welchen station. It has been estimated that some 80 per cent of the total power consumed by the whole of the Bavarian network can be supplied exclusively by water power, owing to the reserve of the Welchen lake, and only 20 per cent will be taken from steam stations. Of the total power available under the scheme, it is expected that 500,000 kw. will be earmarked for the electrification of railways and for the supply of future large works, while 110,000 kw. at first (and 225,000 kw. later) will be taken up for distribution in the electric network.—*Technical Review,* Sept. 2, 1919. (Abstracted from *Le Génie Civil,* July 19, 1919.)

Traction

Leakage Resistance of Street Railway Roadbeds and Its Relation to Electrolysis of Underground Structures.—E. R. SHEPARD.—Several methods of making electrical resistance measurements on street railway roadbeds and on experimental roadbeds are described, and the results of such measurements are given in tabular and graphical form. Certain conclusions are reached regarding the best type of roadbeds and the best methods of treating ties where the reduction of stray currents is important.—*U. S. Bureau of Standards Technologic Paper No.* 127, Oct. 6, 1919.

The Production of Energy for Electric Traction.—A. BARBAGELATA.—The energy required by all Italian railways amounts to about 1,000,000,000 kw.-hr. and the maximum output at least to 800,000 kw. If the cost of a ton of coal is 70 lire, each kilowatt would pay only 175 lire per year. These figures show the low efficiency of a plant feeding electric railways exclusively. In order to reduce to the minimum the cost of the energy for traction it is necessary that the plants furnish energy for general use as well as for traction. Two methods can be employed for this purpose, the first, the American method, consisting in utilizing the same machines and the same high-pressure main both for traction and for general use; the second, the Italian method, consisting in installing in the central stations, generally private, special machines exclusively destined for traction purposes. The method already cited of special central stations exclusively for traction is adopted in Switzerland and will be called the "Swiss" method. The author examines for each type of system adopted for traction—direct, single-phase and three-phase—which one of the three methods is to be preferred. At first sight the American method appears as always being the most economical, but considerations of systems of traction and of security of operation do not always bear out this view. In particular, the author concludes that for three-phase and single-phase traction at a frequency of 16 cycles the Italian method is the most economical; for direct current, the American. But so far as the system itself is concerned the author considers that the high-pressure direct-current system is preferable to others, as it reduces to the minimum the cost of the kilowatt furnished to the secondary.—*Science Abstracts, Section B,* July 31, 1919. (Abstracted from *Elettrotecnica,* May 25, 1919.)

Electric Railways.—M. SEMENZA.—The most economical solution of the problem of the electrification of railways, especially the Italian railways, is examined in this article. The conclusion is that energy for railways should be derived from central stations feeding other consumers at the same time, and that the expense for sub-

stations would be greatest for the three-phase, intermediate in amount for single-phase and least for the direct-current system. The author is, therefore, in favor of the adoption of high-pressure direct current for the Italian railways.—*Science Abstracts, Section B,* July 31, 1919. (Abstracted from *Elettrotecnica,* June 5, 1919.)

Proposed Electrification of the French Railways.—A. MAUDUIT.—The author considers that it will require twenty years to carry out a fairly complete program. At present electrification has been confined to 150 km. of the Chemins de Fer du Midi. The possibilities with regard to other lines are considered, and with a view to the general discussion of the question, and in order to ascertain the advantages and suitability of the different systems, a résumé is given of the work of this sort which has been carried out in other parts of the world. The first section deals with the three-phase system with special reference to Italian railways; the next deals with single-phase work, with particulars of work done in the south of France, Switzerland, the United States, etc.; the third deals with high-tension direct current. The paper contains much information with regard to all systems that are considered suitable for traction on main lines.—*Science Abstracts, Section B,* July 31, 1919. (Abstracted from *Soc. Franc. Elec., Bulletin* 9, March, April and May, 1919.)

Electrophysics and Magnetism

Bibliography of Scientific Literature Relating to Helium. — This publication contains a bibliography of the scientific literature relating to helium published up to Jan. 1, 1919.—*Bureau of Standards Circular No. 81,* Sept. 10, 1919.

Soft X-Rays.—H. M. DADOURIAN.—Soft X-rays were produced by the impact of electrons from a hot-lime cathode against a platinum anode. Potentials of 20 volts to 1000 volts were used to give the electrons the desired velocity of impact. The properties of the rays were studied by observing the velocity and number of electrons produced on a brass plate by a narrow beam of soft X-rays. —*Physical Review,* September, 1919.

Electrochemistry and Batteries

Electrolysis in Concrete.—E. B. ROSA, BURTON MCCOLLUM and O. S. PETERS.—This manuscript constitutes a revision of a former paper on "Electrolysis in Concrete," issued March 19, 1913. It contains the results of a series of long-time tests which show that with reinforcing iron anodes at very low current densities rusting of the iron and cracking of the concrete eventually occur. In the specimens under test damage became apparent in from four to eight years. The cathode effects noted in former tests had not progressed much beyond the point reached at the end of the first two or three years.—*U. S. Bureau of Standards, Technologic Paper No.* 18, Aug. 1, 1919.

Units, Measurements and Instruments

Galvanometry.—H. ABRAHAM and EUGENE BLOCH.—A description, taken from *Comptes Rendus,* of the galvanometers developed during the war for the needs of the radiographic and geographic service of the army. The employment of a soft-iron armature moving upon pivots, balanced mechanically and magnetically, was an outstanding feature of the apparatus perfected.—*Revue Generale de l'Electricite,* Aug. 30, 1919.

Telegraphy, Telephony and Signals

Study of Electrostatically Coupled Circuits.—W. ORLAND LYTLE.—The paper tells, first, of an investigation of the mathematical theory of electrostatically coupled circuits and of the experimental verification of the conclusions drawn, and, second, of the study, by means of the Braun tube and sustained oscillations, of the relations existing between the variables in the electrostatically coupled circuits, using various values for the coefficient of coupling. It is found by theory and also by experiment that by one method of tuning as the circuits are coupled closer one wave length remains constant while the other approaches infinity, thereby concentrating an increasing proportion of the energy in the one wave. It is shown by curves and by Braun tube figures that when the ratio of the two wave lengths is a whole number the root-mean-square value of the current is a minimum.—*Proceedings Institute Radio Engineering,* August 1919.

On the Multi-Section Quenched Gap.—M. SHULEIKIN.—The author considers the relation between the breakdown voltage of a series of quenched-gap sections and that of a single section. Because of electric flux leakage from each plate to nearby plates and neighboring conductors the relation of direct proportionality does not hold. The breakdown voltage of a number of gaps of given length cannot be made to exceed a limiting value, given in the paper. The limiting value in question is shown graphically for various values of flux leakage and breakdown voltage of gap. When spark circuit and antenna circuit are coupled magnetically, the available limiting breakdown voltage is twice that for direct coupling with one side of the high-voltage transformer grounded.—*Proceedings Institute Radio Engineering,* August 1919.

Methods of Detection of Sound Under Water.—W. H. BRAGG.—It is known that sound can travel readily through the sea and be detected at distances of many miles. This fact has been taken advantage of in the methods of submarine signaling which had already proved of use before the war. One of the most striking developments for the detection of submarines during the war has consisted of a method of sound ranging under water, by which it is possible to fix with great accuracy the positions of points hundreds of miles from shore. It has been shown that the shock of an explosion under water creates a sound pulse with a very sharply defined front which can travel unchanged in character under water for great distances. A number of submerged hydrophones are laid a few miles apart from each other at suitable distances from the shore and are connected up to a recording galvanometer in a central station. Six hydrophones are generally employed, and the records of the six are photographed on a moving strip of cinematographic film. As long as nothing happens the records come out as six unbroken lines. If an noise strikes one of the hydrophones, the spot of light is instantaneously deflected and the continuity of the line is broken. By measuring the intervals between the times of arrival of the sounds on the various hydrophones, it is possible to locate the origin of the noise.—*Times Engineering Supplement,* July 1919.

Tree Telephony and Telegraphy.—GEORGE O. SQUIER. —The author first deals with preliminary experiments on the use of growing vegetation for antenna systems. Data are given on ground connections to trees.—*Journal Franklin Institute,* June, 1919.

Readers' Views and Comments

Load Factor Regulation by Synchronous Condensers

To the Editor of the ELECTRICAL WORLD:

SIR: I was interested in the following comment on page 562 of the ELECTRICAL WORLD for Sept. 13: "Synchronous condensers may be used either to improve the voltage regulation or to improve the power factor."

A little study of the operation of synchronous condensers shows that they can be used to maintain unity load factor on hydroelectric power stations or transmission liines or on any system where long high-voltage circuits are involved. When the load factor is held constant the need for voltage and power-factor control disappears because the lines may be designed for maximum economy at one fixed load. At the prevailing high costs of hydroelectric station and transmission line construction and the rapidly rising cost of fuel for peak power, the operation of power houses and transmission lines at unity load factor becomes increasingly important.

Berkeley, Cal. L. N. ROBINSON.

Money Not the Only Reward for Accomplishments in Research

To the Editor of the ELECTRICAL WORLD:

SIR: Considerable discussion of the problem of stimulating research has occurred recently in the technical press, particularly in England. It has been suggested that each individual piece of research carried to a successful conclusion should be rewarded. Such a policy may be the only solution in laboratories like the Mellon Institute, where a research man is employed to solve one particular problem and where his employment is terminated or changed in character upon completion of that particular problem. But in research laboratories of more general character, in which each man is engaged to tackle any problem that comes up for which he is fitted, such a policy would naturally lead to secrecy and an unhealthful state of competition and jealousy that would tend to ruin the atmosphere of the laboratory. As long as a concern finds it worth while to employ a research man and to keep him in its employ he becomes more and more valuable to the company and should receive a steady increase in salary. If the time comes when the concern does not feel inclined to increase his salary any further, that condition—barring abnormal circumstances—generally implies that the research man has reached either the limit or the end of his usefulness to the concern, and if he is dissatisfied with this condition he had better look elsewhere for employment. It is, of course, very difficult to gage the value of a certain research man to a company, and each individual case will have to be treated separately, but, in general, I believe that compensation arranged along the line outlined above will meet with success.

It should be remembered, however, that money reward is not the only reward that a scientific man appreciates. Frequent expression of approval of his work by his superiors—when it is deserved—is an excellent stimulus to continued effort and should never be omitted. Opportunity for broadening out both inside and outside his own sphere is another means of reward that is appreciated and demanded by all scientific men. Such opportunities include library facilities, conferences with co-workers, lectures, the writing of scientific papers, and, last but not least, attendance at meetings of scientific organizations.

T. D. YENSEN.

Research Laboratory, Westinghouse Electric & Manufacturing Company.

Turbo-Generator Troubles in Western Canada

To the Editor of the ELECTRICAL WORLD:

SIR: In the last year or two a very interesting source of trouble in power plants in western Canada has come to notice. Up to date five turbo-generators, totaling 10,000 kw., have been put out of commission by this trouble. The machines are mostly of foreign make. Very little trouble has been had with the American makes of machines. The trouble first appears as a slight vibration of the entire generating set. Next some of the turbine rotor blades are stripped. As the trouble grows worse the vibration increases to a dangerous point. In the machine at Calgary, Alberta, Canada, the trouble was discovered to be of an electrical nature. This was determined by disconnecting the turbine from the generator and running the latter as a motor. The vibration is entirely due to the generator.

The nature of the trouble experienced seemed a high-resistance short circuit in part of the generator rotor-field windings which operates under centrifugal force. When the machine was running at low speed no vibration was noticeable, but at about half speed the short circuit in the windings appeared and vibration was produced by a magnetic unbalance of the rotor. Upon looking up the manufacturers' drawings of the rotor the insulation of the windings was found to be fullerboard and presspan, a class of insulation which American manufacturers discarded some time ago. In practically all five instances of these electrical troubles the symptoms were the same and resulted in stripping the turbine blades. Some of the machines have been rewound two or three times without success, which goes to show that the electrical designs are at fault. Engineers in this section of the country have thus had it brought to their attention very emphatically that micarta insulation is the best kind of insulation for generator rotor-field windings.

It is a well-known fact that upon short circuit of an alternating-current generator, or even with sudden increases of load, there is an induced voltage in the field windings which is a good many times the normal excitation voltage. In the large power plants built recently in the States the designing engineers have put small electrolytic cells in parallel with the field windings as a bypass. Thus the voltage across the field windings cannot be greater than the discharge voltage across the cells. The writer has had no operating experience with these electrolytic cells, but they seem to be a very inexpensive source of protection for just such trouble as mentioned above. The electrolytic cells of the large plants have been applied to large turbo-generators, but it would seem to be more necessary to protect small machines in this manner than large ones, because in a small machine there is usually less room for properly insulated coils.

Calgary, Alberta, Canada. J. N. LIGHTBODY.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

This issue of the ELECTRICAL WORLD *is the fifth that has been published at Buffalo, N. Y., owing to the troubles in the printing trade at New York City, now over, as announced last week. It is also the second of the combination issues arranged to make it possible to catch up with the calendar by the first of the new year.*

Coal Situation Acute

Shortage of coal and the serious danger to electric service resulting from the bituminous strike have become very acute problems for central stations in a number of cities. John W. Lieb, chairman of the National Committee on Gas and Electric Service, called a meeting which was in session in New York as this issue went to press. The entire subject has also been discussed at other conferences, and it is recognized as one that calls for drastic action. Fortunately, the public service commissions appear to be thoroughly awake to the importance of any steps that will safeguard coal and ward off the danger impending in some communities of far-reaching curtailment of service.

Both the New York City and the upstate New York commission held conferences with public utility representatives on Dec. 4. Mr. Lieb said to Commissioner Nixon that he hoped that more definite instructions would be issued from Washington so that the extent to which the companies ought to go in coal conservation could be more plainly understood. Curtailment of sign lighting would save little coal but would help to impress the importance of conservation on the public.

According to reports to the ELECTRICAL WORLD, the danger of serious curtailment of electric service as a result of the coal strike is greater in the Central West and the Southwest than in other sections of the country.

Heavy rainfall this week in the Sierra Nevada Mountains assures California's water supply for power and irrigation next summer.

Negotiations are being conducted by the War Department for the sale of $2,000,000 of surplus electrical equipment to European governments, including the entire supply of surplus copper wire and cable.

Building is continuing in nearly every part of the country, and supplies for this work are constantly draining jobbers' stocks. Contracting on the Pacific Coast, however, is reported slowing up. The run on wiring and schedule materials is heavy, and in various localities jobbers' prices have advanced 2 to 5 per cent on schedule material in general or 3 per cent on sockets and 2 cents on tubes, knobs and rigid-conduit boxes and covers.

A heavy windstorm on Nov. 29 damaged transmission and distribution systems in Indiana, Ohio, lower Michigan and Illinois. The damage to the electrical system in Detroit alone will be $50,000.

In order to cut the power load in the city of Niagara Falls, Ontario, 40 per cent, an order has been issued by the Ontario Hydro-Electric Commission to cut off all sign and outside lights, to use electric light as little as possible in homes and not to use heaters in residences at all between 4 p. m. and 6 p. m. Power users have been asked to return to daylight saving, starting early and closing down at 4 p. m. These restrictions have been found necessary during the season of maximum yearly peak demand on account of large increases in lighting and industrial loads during the past year.

A meeting to organize a New York Section of the American Institute of Electrical Engineers is called for Dec. 10.

President Ballard of the National Electric Light Association announces that the committee on water-power development under the chairmanship of Franklin T. Griffith will include as members William A. Brackenridge, John A. Britton, H. T. Edgar, G. C. Egbert, Mortimer Fleischhacker, H. I. Harriman, D. L. Huntington, H. F. Jackson, Frank M. Kerr, W. S. Lee, A. W. Leonard, J. D. McKee, G. W. Talbot, A. B. West and A. G. Wishon. A complete investigation of the water-power resources of the country, both developed and undeveloped, will be undertaken.

The committee on co-operation in the industry of the National Electric Light Association, as announced by President Ballard, is: Lee H. Newbert, chairman; Robert Sibley, John J. Gibson, D. R. Bullen, M. S. Seelman, Jr., R. S. Hale, William Creighton Peet and Frank Price.

Following the investigation of inductive interference between electric power and communication circuits, conducted at the direction of the California Railroad Commission, the commission has published selected technical reports on the subject, together with the preliminary and final reports of the joint committee and the commission's order for the prevention or mitigation of such interference. The book is published at cost, $10.

J. M. Wakeman, general manager Society for Electrical Development, has returned from Toronto, where he addressed the Toronto Division of the Ontario Association of Electrical Contractors and Dealers on Nov. 24. There were present fifty association members, besides representatives of the Toronto Hydro-Electric System and the Hydro-Electric Commission of Ontario. Among suggestions which Mr. Wakeman made were the establishment of an electrical page in a leading Toronto paper and the holding of an electrical exposition in Toronto early next year, with the possibility of having a building devoted entirely to electricity at the great Canadian National Exhibition held each fall in Toronto.

Important meetings to take place soon in Chicago are: American Institute of Electrical Engineers, committee on oil switches, Dec. 16; joint meeting Chicago Electrical Society, Society of Western Electrical Engineers and A. I. E. E. to be addressed by Alex Dow, president Detroit Edison Company, on power supply, Dec. 16; National Electrical Credit Association, Dec. 11 and 12.

The Ohio Electric Light Assocation held a special mid-year meeting in Dayton on Dec. 3. The dues of active members were raised; action was deferred on the proposition to become part of a geographic section of the National Electric Light Association, and fuel and safety problems were discussed. W. W. Freeman of Cincinnati gave out the information that no orders requiring central stations to limit the supply of electric service to customers had been issued from Washington. Up to Tuesday morning, Dec. 2, Fuel Administrator Garfield had only suggested curtailments which he would like to see brought about. Mr. Freeman said that in his opinion the function of the utilities was to co-operate with the authorities but not to usurp the police powers of the state.

Recent declines in the copper market, with the base metal quoted at 18 cents, have reacted on the wire market. Bare wire at the mill is quoted at 21 to 21.50 cents net. Manufacturers of rubber-covered wire are working on more diversified bases, from 25 to 30 cents, averaging 28½ cents. Lamp cord is scarce and is selling higher. Sales of larger size than No. 14 code wire are forming a bigger percentage of the total sales of code wire. Wooden poles are reported higher in price, with a still further advance expected because of the lack of the labor necessary to cut them. Cross-arms are expected to follow.

Plans have been completed by the New York Edison Company for the erection of a new three-story transformer station, 42 ft. by 75 ft., at 421-423 East Sixth Street. The cost of the building is estimated at about $60,000.

Summarized News

Principal Happenings Up to Closing of Forms for This Issue— Printed Dec. 8

STATE LIGHTING CODES DISCUSSED AT NEW YORK

I. E. S. Meeting Considers Industrial Lighting Codes for Benefit of Electrical Contractors, Factory Engineers and Executives

At the recent annual meeting of the Illuminating Engineering Society in Chicago papers were presented outlining recent progress in developing standards of factory lighting and in putting them into effect. These papers were discussed at the New York section meeting on Nov. 13 for the particular purpose of interesting electrical contractors, factory engineers and executives in the value of getting the wiring and equipment properly installed in the first place.

It was said that great progress has been made in industrial plants by equipping a single room or department with modern lighting. In such instances the results have been so good in improved morale and increased production that factory executives have voluntarily rearranged the lighting of their whole plants. It was the consensus of opinion, however, that small electrical contractors do not generally recognize the importance of illuminating engineering principles in the installation of new work. The efforts of the various industrial commission engineers and inspectors are thus being directed into a strenuous campaign of education for the small contractor.

TURBINE SITUATION IS DISCUSSED BY A. I. E. E.

Present Limits of Speed and Output of Single-Shaft Turbines and Generators the Topic of Evening

Fully 250 designing and operating engineers assembled at the New York meeting of the A. I. E. E. on Nov. 14 to discuss the present limits of speed and power of single-shaft turbines and generators. In the discussion which followed the presentation of the three papers of the evening by J. F. Johnson, Eskil Berg and F. D. Newbury, B. A. Behrend emphasized the need of more seriously considering vibrational stresses and ductility. W. L. R. Emmet declared that larger turbines are not justified in his opinion, and expressed himself in favor of independent rather than compound units. He also referred to some interesting experiments which are being conducted with rubber disks to determine the nature of vibration of turbine disks.

W. J. Foster pointed out that the rotor is the limiting feature in 60-cycle 80-per-cent-power-factor machines and contended that radial ventilation is preferable to axial. In 11,000-volt generators the temperature drop through the insulation, laminations and air at the middle of the machine is in the proportions 31:4:12 respectively. F. Hodgkinson defended multiple-shaft turbines on the grounds that the temperature range in each unit is reduced, the stresses correspondingly reduced and each element better adapted to operating conditions. Prof. C. A. Adams, who called attention to fatigue tests that are being conducted at the University of Illinois under the auspices of the National Research Council, questioned whether vibrational stresses within the elastic limit produce fatigue. Farley Osgood emphasized the importance of reliability of service and said that a turbine breakdown not only means loss of capacity but loss of time of use. To reduce the delays caused by breakdowns Mr. Osgood urged designers to use standard materials rather than materials requiring special treatment.

The meeting was opened by President Calvert Townley, who subsequently turned it over to Philip Torchio, chairman of the power stations committee, under whose auspices the meeting was held.

W. W. FREEMAN IN SOCIETY FOR ELECTRICAL DEVELOPMENT

Head of Union Gas & Electric Company of Cincinnati Succeeds Henry L. Doherty as President of Society

At a meeting of the directors of the Society for Electrical Development in New York on Nov. 11, W. W. Freeman was unanimously elected president, succeeding Henry L. Doherty, who has held that office since the society was founded nearly six years ago.

As president of the Union Gas & Electric Company, Cincinnati, Mr. Freeman is well known to all branches of the electrical industry. Under his leadership the society will continue to work to co-ordinate and assist all branches of the industry to bigger and better business as well as to carry to the public the message "Do it electrically."

The extent of the work of the society is made evident by extracts from the annual report of the general manager, James M. Wakeman.

This report emphasizes the fact that in spite of the handicap of war the society was able to continue its regular work of supplying articles on electrical subjects to newspapers, trade journals and popular magazines. Valuable publicity for the electrical industry was thus obtained. Particular attention has been paid to developing the demand for household appliances and for motors for industrial purposes. The society has under way a campaign for better industrial illumination.

The monthly sales service has been regularly issued and its general character not only maintained but improved.

Now that members have become familiar with the character of special services which they can receive from the society, requests for this sort of help are being received daily. These range all the way from information wanted on voltages of lighting circuits in foreign cities, heating and cooking rates in American cities, numerous uses of electricity in the various industries, down to the names and addresses of manufacturers of this or that electrical device or the preparation of advertising copy and the outlining of a special sales campaign.

Visitors have been received from England, Switzerland, France and Japan, all with the object of studying the methods of the society and with a view to inaugurating similar organizations in their own countries.

The society is now conducting another of its national campaigns in the drive for an "Electrical Christmas."

In addition to the election of Mr. Freeman as president, two new vice-presidents were also unanimously elected by the directors, Fred Bissell of the F. Bissell Company, Toledo, representing the electrical jobbers' fraternity, and James R. Strong of the Tucker Electrical Construction Company, New York, representing the electrical contractors and dealers.

Charles L. Edgar, president Edison Electric Illuminating Company, Boston, was appointed director representing central-station interests in place of E. N. Sander-

son, resigned. Arthur J. Binz, Houston, Tex., newly elected Jupiter of the Jovian Order, was appointed to the board in place of L. O. Ripley. J. E. Montague was elected chairman of the new executive committee.

EXHIBITORS WANT ANOTHER SHOW IN CHICAGO NEXT YEAR

Chicago Electrical Show Proves Good Business Getter for Exhibitors from Widely Different Branches of the Industry

"We want another Electrical Show in Chicago next year" was the expression of nearly every one who had a booth at the very successful Chicago Electrical Show, which closed on Oct. 25. It was a show which brought direct results to many and prospective business to all who took full advantage of the opportunities which presented themselves. One concern admitted getting in touch with prospects for $100,000 worth of business and another sold 165 vacuum cleaners to a dealer in one day. The attendance was not at all confined to those interested in household devices. For example, some visitors wanted to buy an outdoor substation, an electric furnace, industrial lighting equipment, or the service of a testing laboratory, and in each case exhibitors were able to supply the need.

At a meeting of exhibitors with E. W. Lloyd, general manager of the show, tentative plans were formulated for next year's exhibition.

PUBLIC SUPPORT ESSENTIAL TO TECHNICAL EDUCATION

Comparative Youth of Engineering Graduates and Value of Technical Training Afford Opportunities for Popular Co-operation

"It is within the experience of all of us," said President R. C. Maclaurin of the Massachusetts Institute of Technology at a meeting of the alumni council, "that the war has swept away the old standards and ushered in a new era when expenditures are necessarily on an entirely different scale from that of former days. This change has come upon the colleges so suddenly that they are practically all in financial difficulties and all calling loudly for help. I do not know of any that does not need what it is asking for, and I earnestly hope that they will all get what they are seeking."

Dr. Maclaurin's address was given in connection with the campaign to raise a fund of $10,000,000 for the institute, and in the course of his remarks he pointed out that the mysterious "Mr. Smith," whose benefactions have been of so much aid in the past, has offered to give half the money needed (a minimum of $8,000,000 is sought) if the other half is forthcoming within a reasonable time.

The Institute of Technology, like other engineering schools of the highest rank, occupies a field of education that is especially expensive. "The nature of its business," said President Maclaurin, "calls for an elaborate and costly equipment and a very large number of very high-grade teachers. The fundamental problem to-day is to provide adequate salaries to attract and retain teachers of the first quality, for, of course, Technology cannot continue to do the great work that has characterized it unless it continues to attract men of the highest type to its faculty. There is one reason not generally appreciated why a low grade of salary at Technology presents more serious difficulties than at an educational institution of any other type. This arises from the extraordinary demand that there is to-day for technically trained men. Industry is calling loudly for these men and is ready to offer them salaries very much larger than the institute can afford. Whereas in some other institutions an increase of salary is based mainly on notions of social justice, at Technology there is the additional and very cogent reason that good men simply cannot be had unless the salaries are raised."

There can be no question, said the speaker, that the technically trained man will be needed vastly more in the future even than to-day. The social unrest that characterizes our time will not pass with mere talk. It can only be allayed by increasing the wealth of the country, and this inevitably means greater production, the discovery of new sources of wealth and improvement of old means of manufacture. There is no part of the country where this should come home to thoughtful minds with more telling force than in New England, where industry is practically the sole source of wealth.

Dr. Maclaurin pointed out that the almuni of the Institute of Technology have always been loyal and generous, but that not one man in a thousand appreciates the fact of fundamental importance in such a campaign as is now under way, namely, that the alumni are altogether too young to be able to make large contributions. The institute was a very small affair during the first thirty years of its existence, and far more than one-half of its alumni have gone forth within the last ten years. About 7000 graduates are on the rolls and about 5000 non-graduates are listed. There are not many more than 500 of the graduates alive to-day who are over fifty years of age.

"This youth of the alumni," said President Maclaurin, "is a splendid asset for the future, but for purposes of direct contributions of money it places the Institute in an unfavorable situation as compared with other institutions that have had large numbers of older and richer alumni. I have no doubt that generous citizens in Massachusetts will support the institute if they know its needs, and the almuni must help in making those needs known. It is held in high esteem everywhere, and special emergencies have for a time focused attention on its possibilities for service to the community. Recently, as you know, Technology men did an excellent service in organizing the fire brigade to protect the lives and properties of people in Boston in case the firemen followed the unfortunate lead of the policemen. Happily, they remained true to the city.

"The services of Technology during the war have made a great impression on those who know of them. The single fact that Technology alumni entered the national service by the thousands and that nearly 77 per cent of them became officers indicates the value of technically trained men in the great emergency of war. We want, however, the citizens of Massachusetts to understand that these men have an equal value in the relatively quiet times of peace. Fortunately, in this respect Technology can point to the actual achievements of its alumni and need not merely speak of what it is hoped can be done in the future. It is easy to point to the great savings that have been made in industrial processes by the accomplishments of Technology men and to the great developments in industry that have been brought about through their initiative. 'I like the Massachusetts Institute of Technology,' says Thomas A. Edison, 'because it is turning out men that the country needs.' To continue to turn out

these men we need now the practical support of generous men throughout Massachusetts, and we naturally look primarily to those who are engaged in industry and appreciate the growing importance to industry of the technically trained men."

BASIS OF RATE INCREASES MADE IN PROVIDENCE, R. I.

Committee of City Council Finds That Narragansett Electric Lighting Company Needs More Revenue to Meet Costs

A new rate agreement, providing for an increase of between 10 and 15 per cent in power and commercial lighting rates, has been authorized by the Common Council of Providence, R. I., for execution with the Narragansett Electric Lighting Company. A committee of the council, after investigation, upheld the contention of the company that additional revenue was needed to meet higher cost of production.

In part the committee said in its report:

In its petition the company sets forth that, in 1917, labor charges of all kinds were about $574,000. During the current year these charges have so ranged that it is estimated that the close of the fiscal year will result in these charges aggregating about $846,000, and, estimating the labor cost for 1920, the company expects this to reach a total of about $930,000, or about 62 per cent more than in 1917.

As to tax charges, it is asserted that for 1917 the company paid $149,354.88, whereas the estimated tax assessments for 1920 loom ahead with a figure of $289,000, an advance of about 94 per cent.

In 1917 the company sold in the district which it serves about 81,000,000 kw.-hr. of electricity, and for 1920 the company expects this to advance to about 122,000,000, or an increase of approximately 51 per cent. Although an increase in output normally entails a less proportionate increase in labor costs therefor, yet, figuring on this basis of 51 per cent, it appears there would be an increased cost due to new business of about $368,000, whereas the amount of increase since 1917 in costs of labor and taxation will be for 1920 about $495,000. Increased costs of materials also furnish a factor which will also cut into the company's revenue. In view of the above the company has asked for a change in its rates for power and commercial lighting customers that will provide for an increased gross revenue of about $150,000.

The statements of facts in the company's petition regarding increase of pay rolls and taxes and as to the amount of increase in revenue to be expected from the proposed change in rates have been found to be substantially correct by the public service engineer. He estimates that the total number of consumers in Providence who will be affected by the proposed changes will be about 1600, or about 8½ per cent of the total number of consumers in Providence. Those affected will include practically every class except residence customers on the so-called domestic lighting rate, A, and domestic heating and cooking rate, E. The percentage of increase is variable, but with a few exceptions varies from 8 to 15 per cent for most consumers, except those large users coming under the so-called Providence power rate, G, in which case it varies from 12 to 17 per cent.

In general the result is an increase in the average price per kilowatt-hour which is small, but by reason of the wholesale prices already in effect it produces the percentage increases noted above. The committee as well as the public has learned that the company is preparing to experiment with the use of oil instead of coal as a fuel. If this change shows the expected economy it is hoped that the increases now proposed may be fully or partly offset by a readjustment which must naturally follow the realization of such economies.

So long as its statement of facts and its financial statements satisfied the careful scrutiny of the public service engineer, the committee approached this petition of the lighting company from the viewpoint that the best interests of this community warrant giving such protection to this company as will insure its past and present stability. Your committee believes that public policy requires a sanction of such rates for this public utility as will permit of its giving good service and the maintenance of a healthy financial condition that will retain and attract the support of capital.

It should not be forced to do business at a loss; neither should it be required to draw materially upon surplus funds so long as such surplus is not maintained at an excessive amount. In this connection, therefore, your committee suggested and secured the company's agreement to make this proposed change in rates indefinite as to period, so that in the event of a change in conditions, or a much larger result as to gross revenues than is estimated from the new rates, the city may at any time reopen the case for a further inquiry as to such rates. In other words, a trial period is arranged for, and this, it is believed, will amply protect the public as to future conditions.

IMPORTANT INTERCONNECTION PLANNED FOR BOSTON SYSTEM

Boston Edison, Quincy and Weymouth Systems to Be Tied Together for Large Business Development of the Future

Contracts for interconnection have been executed by the Edison Electric Illuminating Company of Boston with the Quincy Electric Light Company and the Weymouth Electric Light Company for twenty years. The construction of a transmission tie line between the L Street station of the Boston company and the two other central stations named will be completed next year.

In the case of the Quincy company the demand will be approximately 1500 kw. and the guaranteed yearly consumption of energy 5,000,000 kw.-hr. The Weymouth company has contracted for a minimum of 5,000,000 kw.-hr., and the load of this company will reach about 1700 kw. in summer, when the Nantasket Beach load is at its height, and will average about 1200 kw. in winter, when the summer load is not in operation. The Weymouth company has a considerable steam-heating load which makes winter operation of its plant desirable, using exhaust steam to its full extent for heating purposes.

Two 300,000-circ. mil cables will be installed to connect the three companies' plants, 25,000-volt transmission being employed. A 4000-kw. transformer station will be erected outdoors on the Quincy company's property adjoining its existing steam plant, and the latter will be shut down when the new service is inaugurated. The interconnection will place both the Quincy and the Weymouth companies in a position to handle large power business in their respective fields.

GUARANTEED RETURN IS AUTHORIZED IN WISCONSIN

Kenosha Enabling Act Legalizes Contract with Public Utility for Joint Agreement Involving Municipal Guaranty of Return

Wisconsin has a new law, known as the Kenosha enabling act, which authorizes cities of the third class and villages to contract with any public utility, street or interurban railway for the lease, purchase, improvement, extension, partnership, ownership or operation of such utility or for minimum rates in consideration of a return guaranteed by the municipality.

It provides that "any city of the third class or village served by any privately owned public utility, street railway or interurban railway rendering local service may contract with the owner thereof upon any terms not repugnant to the constitution and laws of the State of Wisconsin for

the leasing, public operation, joint operation, extension and improvement by the municipality or with funds loaned by the municipality, for the stabilization by municipal guaranty of the return upon or for the purchase by installments out of earnings or otherwise of that portion of said public utility, street or interurban railway which is operated within such municipality and any territory immediately adjacent and tributary thereto, or for the accomplishment of any object agreed upon between the parties relating to the use, operation, management, value, earnings, purchase, extension, improvement, sale, lease or control of such property."

The Railroad Commission, the law provides, shall cooperate with the parties in respect to making valuations, appraisal, estimates and other determinations specified in the contract.

STATEMENT OF PUBLIC UTILITY LABOR DISPUTES

New Wisconsin Law Provides for Board of Conciliation with Adjustment of Rates by Railroad Commission if Necessary

A new law enacted in Wisconsin this year provides a means of settlement of labor disputes, including those in public service corporations. Under it the Railroad Commission will have authority to advance the rates of such corporations in order to enable them to meet the wages, hours of labor and working conditions for employees which may be determined to be fair by the method laid down.

Section 1 of this law creates a board of conciliation to consist of three members, one of whom shall be a skilled employee but not having employing or discharging power, one of whom shall be an employer of labor. and one of whom shall have a general knowledge of manufacturing and labor conditions. The Governor, by and with the advice and consent of the Senate, shall appoint such members. The term of the first appointee shall terminate on the first Monday of February 1920, of the second on the first Monday of February 1921, and the third on the first Monday in February 1922. In January 1920 and annually thereafter there shall be appointed one member for the term of three years. Each member shall receive five dollars per day when actually and necessarily engaged in the discharge of his duties as a member of such board, together with his actual and necessary expenses incurred in traveling.

Section 2 stipulates that whenever any dispute shall arise between an employer of more than twenty-five persons in a common employment and his employees over the wages of such employees, such employer, or any number of such employees more than one-half working in a common employment, may request the board of conciliation to investigate and report as to what is a fair, equitable and just wage for such employees under all the circumstances surrounding both such employer and his employees. The board may, upon receiving such request, investigate and report as to what, in its opinion, is a fair, equitable and just wage under all the circumstances surrounding both such employer and his employees.

"In the event that such dispute shall arise between any public service corporation and its employees of any class, division or grade," says the law, "and said board of conciliation shall investigate and report thereon as herein provided, and determine the wages, hours of labor or working conditions to which such employees are reasonably entitled, such determination shall be immediately submitted to the Railroad Commission of Wisconsin, which Railroad Commission shall without delay further investigate the said matter and make and file its determination therein, confirming or modifying the report of said board within forty-five days after receiving the same.

READJUSTING RATES TO MEET INCREASED LABOR COST

"If the earnings of such public service business in which such employees are engaged are found to be sufficient to meet the cost of making the determination of the said commission effective without depriving said corporation of a fair return upon the capital employed in such business, as determined by the Railroad Commission, said Railroad Commission shall order such public service corporation to make effective the wages, hours of labor and working conditions so determined by it to be fair, equitable and just; otherwise the commission shall provide for such a revision of the rates, tariffs and charges of such public service business as will enable it to meet such cost and yield a fair return upon the capital employed therein, as determined by the Railroad Commission, which order of the Railroad Commission shall be subject to review in the manner now provided by law for the review of orders relating to the rates and service of the public service business affected by the order sought to be reviewed."

Under Section 3 the board is given authority to employ necessary experts, etc.

Section 4 says that for the purpose of making such investigation and report the board may issue subpoenas and compel the attendance of witnesses and the production of books, records, papers and documents. On the refusal of any witness to testify it shall be the duty of the circuit court of any county or the judge thereof, on application of the board, to compel obedience by attachment proceedings for contempt.

Section 5 grants the right to inspect the books, records and papers of any employer under investigation and to examine under oath any officer, agent or employee of such employer, provided that any person other than a member of the board who shall make such demand or conduct such examination shall first produce his authority for taking such action.

Section 6 provides that no person shall be excused from testifying or from producing records on the ground that this may tend to incriminate him, but no person having so testified or produced such records shall be prosecuted or subjected to any penalty therefor, provided that no person so testifying shall be exempted from prosecution or punishment for perjury. Any person who shall willfully interfere with the conduct of any examination, or shall willfully testify falsely, or who shall willfully refuse to produce any record, etc., in his possession or under his control, shall be guilty of a misdemeanor and, upon conviction, shall be punished by a fine of not less than $100 nor more than $1,000 for each offense.

Under Section 7 the board, after making an investigation, is required to file its written report as soon as practicable. The report shall be open to the public. The board shall furnish certified copies immediately to the employer and to his employees.

Section 8 appropriates such sum as may be necessary to carry out the functions of the board, and Section 9 makes the act effective upon passage and publication.

DEMAND FOR ENERGY IS EXTENSIVE IN DETROIT

President Alex Dow Says That the Reasonableness of Continuation of Advances in Rates Has Not Been Questioned

Present demand and the expectation of permanence in the higher rates made necessary by advances in operating cost are discussed by Alex Dow, president Detroit Edison Company, in a letter to bankers who have bought a block of bonds of the company. The issue of $4,989,000 first and refunding mortgage bonds was offered by the bankers, Coffin & Burr, Inc., of Boston at 89.

"The present peace-time demand upon our plants." says Mr. Dow, "is in excess of the maximum during the war period, and the new industrial business offered to us is greater than at any prior time notwithstanding the advances made during the war period in our rates for industrial power. These advances were in no case temporary allowances or surcharges, but were justified by the permanent increase in operating costs, and the reasonableness of their continuation has not been questioned.

"We therefore have full reason to expect that the earning capacity of the company will continue to increase, and we have likewise reason to expect that the economies which will be possible in the readjustment of our operation to peace conditions, and particularly those which will result from the addition of new generating apparatus and the opportunity to overhaul the machines which have been continuously in service during the war, will all be a net gain."

GEOLOGICAL SURVEY REPORT ON ELECTRICAL POWER PRODUCTION

Government Statistics Covering Output in April Show That 43 per Cent of the Total Was Produced by Water Power

A report on the "production of electric power and consumption of fuel by public utility power plants in the United States" for April 1919 has been compiled by the division of power resources of the United States Geological Survey. The initial compilation of the survey, covering February, was printed in the ELECTRICAL WORLD of May 31, 1919, page 1184. The March return appeared in the ELECTRICAL WORLD of Aug. 23, 1919, page 430.

In making the April statistics public the Geological Survey also issued revisions of its February and March returns on output of electrical energy and fuel consumption. Its corrected "production" by water power in February is 1,148,634,000 kw.-hr. and by fuels 1,834,487,000 kw.-hr., a total of 2,983,121,000 kw.-hr. Its revised production by water power in March is 1,308,329,000 kw.-hr. and by fuels 1,841,837,000 kw.-hr., a total of 3,150,166,000 kw.-hr.

Concerning the number and character of plants whose returns are included the survey now says: "The reports of electric power output and fuel consumption for February, March and April are based on returns received from about 3100 electric power plants engaged in public service, including central stations, electric railways and certain other plants the output of which contributes to the public supply. Returns were received from plants whose aggregate capacity is about 90 per cent of the generating capacity of all public utility plants. Estimates of the output of plants which did not make returns were made from available information. The total estimated power is only about 7 per cent of each monthly total. The average daily output in kilowatt-hours for the different months is as follows: February, 106,540,000; March, 101,620,000; April, 100,880,000. Amount produced by water power: February, 39 per cent; March, 42 per cent; April, 43 per cent."

In view of a possible curtailment in the coal supply resulting from the bituminous-coal labor situation the Geological Survey calculates the amount of coal required for operating public utilities in the United States. The average monthly consumption of coal by electric power plants engaged in public service for the three months was 2,815,000 tons, or about 95,000 tons per day. This is equivalent to about 2100 carloads of 45 tons per day. The amount needed for electric public utility plants in New England, New York, Pennsylvania and New Jersey is 36,900 tons per day, or about 820 carloads.

Following are the April statistics which are subject to revision in later reports of the survey:

	Thousands of Kilowatt-Hours Produced		Combustion of Fuels		
	By Water Power	By Fuels	Coal, Short Tons	Petroleum and Derivatives Barrels	Natural Gas, Thousands Cubic Feet
Alabama	28,488	4,477	14,836	8	0
Arizona	7,577	16,488	5,360	65,824	0
Arkansas	69	6,030	9,902	456	97,726
California	228,775	33,645	0	161,651	273,642
Colorado	15,019	14,365	36,135	98	0
Connecticut	15,804	35,525	58,094	279	*11,309
Delaware	0	4,655	7,000	0	0
District of Columbia	0	18,457	20,983	0	0
Florida	777	7,776	3,056	28,785	3,780
Georgia	31,404	6,200	12,009	167	0
Idaho	36,019	155	121	10	0
Illinois	16,134	194,109	318,378	2,143	0
Indiana	3,511	51,980	143,829	420	1,909
Iowa	48,737	23,646	72,211	743	0
Kansas	913	30,870	48,636	58,432	65,374
Kentucky	4	18,555	37,380	353	0
Louisiana	0	14,582	13,878	28,192	49,599
Maine	18,708	93	357	17	0
Maryland	358	11,442	20,755	30	1,500
Massachusetts	32,322	90,601	129,877	17	0
Michigan	65,211	88,363	113,623	139	0
Minnesota	42,204	7,261	25,038	854	0
Mississippi	0	4,927	16,008	311	0
Missouri	4,418	36,245	82,143	19,519	0
Montana	77,853	821	5,455	488	907
Nebraska	1,118	16,004	29,813	3,433	0
Nevada	2,470	727	140	997	0
New Hampshire	5,683	1,898	3,241	3	0
New Jersey	187	76,642	114,137	80	0
New Mexico	80	1,455	3,627	1,373	0
New York	220,677	270,644	325,474	501	164,956
North Carolina	45,755	7,082	15,612	20	0
North Dakota	0	2,103	14,473	8,085	0
Ohio	3,565	183,702	289,610	764	333,684
Oklahoma	149	12,989	12,203	5,675	477,050
Oregon	27,248	3,539	223	15,456	0
Pennsylvania	58,466	233,597	396,096	16	53,533
Rhode Island	726	16,839	20,819	0	0
South Carolina	43,287	3,676	8,811	93	0
South Dakota	4,104	1,920	4,371	3,091	0
Tennessee	37,999	10,405	24,710	81	0
Texas	305	44,816	26,618	178,033	177,778
Utah	17,434	0	31	0	0
Vermont	19,482	187	246	2	0
Virginia	19,298	16,539	28,453	52	0
Washington	74,575	4,164	2,411	17,879	0
West Virginia	1,642	59,396	69,426	52	180,069
Wisconsin	48,880	24,682	53,037	565	0
Wyoming	138	3,514	12,242	8,840	16,129
Total	1,308,573	1,717,788	2,651,888	614,045	1,908,945
Total, by water power and fuels	3,026,361				

* Artificial gas.

SOUTHERN SIERRAS POWER COMPANY TRAINING PLANS

Arrangement of California Company for Training Young Men as Senior and Junior Students to Enter Its Service

BY E. B. CRIDDLE
General Agent Southern Sierras Power Company

Some two and a half years ago, after a careful study of the plans in vogue elsewhere, the Southern Sierras Power Company and associate companies, with headquarters at Riverside, Cal., instituted a training school for young men entering their employ who were qualified therefor and willing to assume the necessary obligations.

There are two classes, known respectively as senior and junior students. The senior students are technical college graduates or men under twenty-five years of age who have had sufficient technical education and training to be as well qualified as college graduates. This course is for a period of two years, an agreement being signed by the student and by the company upon enrollment obligating the senior student to stay with the company for the two-year period, subject to his giving satisfaction to the company, and to receive compensation at the rate of $80 per month for the first six months, with an increase of $5 per month at the close of each six-month period, so that at the close of the two-year student course he is to receive not less than $100 a month and be ready for rapid promotion as the opportunity may occur.

Junior students are high-school graduates, preferably those who have taken a commercial course, who are under twenty-one years of age and who are ready to sign up for three years as students. They receive $50 per month for the first six months, with $5 per month increase at the end of each six-month period, so that at the close of their three-year term they are to receive not less than $80 per month.

In all cases the young men must have good personal records, both mentally, physically and morally; must be of a type to inspire confidence and must be alert, industrious and dependable.

Upon this foundation the company hopes to build up an organization which will provide an adequate supply of clerks, accountants, plant operators, construction superintendents, power salesmen, etc., each being selected with a view to rapid promotion. It is expected that ultimately the highest positions with the company will be filled from their ranks.

To each is given a period of work in the commercial, billing, accounting and engineering departments in the general office, as well as a few months in one or more of the local offices, going from desk to desk and learning the details of all those departments. Then they have as long as may be necessary at meter testing, plant operating, both hydro and steam, and at line construction. They are given a reading course with their practical work, and a monthly record is kept showing the hours spent each day on any given work, with a monthly report by the department head showing proficiency and qualifications.

From four to eight men in each class can be constantly absorbed by the companies' system.

The war interfered to some extent with the regular progression, but those who came back received credit for experience gained during their period of service and have resmued work either as students or as graduates.

The company is much pleased thus far with the results obtained.

HARTFORD CENTRAL-STATION EMPLOYEES INVEST IN STOCK

Nearly One-third of the Staff Participate in Company's New Savings Plan by Purchasing About 300 Shares

One hundred and forty-three of the 450 employees of the Hartford (Conn.) Electric Light Company subscribed to 298 shares of new stock recently at $200 per share, about three weeks being allotted for entering subscriptions. The directors offered the new shares to employees at slightly below the market price in order to encourage the savings habit developed so successfully during the Liberty Loan campaigns.

Arrangements have been made which provide for weekly payments on the same basis as prevailed during the several Liberty loans. Interest at 5 per cent is charged on all balances carried by the company, and the subscriber will receive all dividends which may be declared during the period of the weekly payments. The first payment will not be due until Dec. 20, at which time the payments will have been completed on the first three Liberty loans. Subscribers who find that they are unable to maintain payments may withdraw at any time, in which case payments will be refunded with adjustment of interest.

An Effective Central-Station Sign Location in Massachusetts City

An unusually effective location for a sign advertising lighting and power service is utilized by the Amesbury (Mass.) Electric Light Company. The company's office fronts on a main thoroughfare making a sharp bend opposite the entrance. The headquarters are in a mill building owned by an affiliated power and real estate organization, and the sign of the company is mounted by iron brackets on the corner of the building as illustrated, with cross-bracing to the second-story window sill and a horizontal conduit feed for the inclosed lamps. H. A. Sawyer is local manager of the company.

EFFICIENCY OF PRIVATE OPERATION EMPHASIZED

Report of John S. Allen of Wisconsin, Presented Before State Utility Commissions, Calls Attention to Public Ownership

A report of the committee on public ownership and operation was presented by the chairman, John S. Allen of Wisconsin, before the National Association of Railway Commissioners at the convention in Indianapolis on Oct. 14 to 17. Several members of the committee dissented from the report, which upheld the efficiency of private operation as compared with public operation.

"The movement toward 'public ownership and operation' has received succor from a wide variety of sources," said Mr. Allen. "The argument that the public should hold in its name the fee and title of those activities which serve the public and which the public regulates is an argument which many people accept as the last word on the subject. The argument that the public can do as it pleases with that which is its very own is in many quarters equally conclusive. One of the arguments that is seldom used, and never can be truthfully used, is that 'public ownership and operation' is more efficient than private ownership and private operation. Instances do exist where a well-managed publicly owned property is more efficient than a poorly managed privately owned property, but these are rare and do not in any way weaken the statement that the final desideratum in a public property is that degree of efficiency which is being obtained under private ownership and operation."

The report summarized the reasons for the impetus given to the movement for public ownership and operation, in part as follows:

1. *The propaganda started by the governmental control of wire lines and railroads.* It was but natural that once the bigger utilities were taken over by the government the movement should be reflected in the effort to municipalize water, gas and electric utilities.

2. *The failure of utility managements to meet the increased demands upon them.* This refers as much to service, depleted and depreciated, as to rates. It was no uncommon thing to find a gas or electric company, or even a water utility, unable to cope with situations which arose, and too often the managements were prone to charge their own shortcomings against the regulatory body which had control over them. Inefficiencies in plant operation were brought to light which the general public never knew existed.

3. *The failure of regulatory bodies, either state or local, to sense the seriousness of situations and to give utilities the needed assistance in time to avert disaster.* This is not meant as a reflection upon any commission, nor upon its policies, but the fact is that in the flood of applications for increases in rates which were necessary to keep utilities alive a regulatory body was not able to discriminate as it should.

4. *The inherent thought with many people that public ownership and operation is a panacea for ills.* So without thought or examination of the possible effect, with the propaganda praise of it ringing in our ears, many people became adherents of, and shouters for, public ownership.

After referring to legislation tending to make the process of public ownership easier Mr. Allen said: "The tendency toward ownership or a supervision which cannot differentiate between regulation and management has been marked. While the figures obtainable show little or no increase in the number of utilities municipalized, and for some utilities actually show a decrease, there is no question but that there is a quite decided awakening of public interest in the matter. Whether this public interest is a flurry as the result of unsettled economic conditions only time can tell."

The committee recommended that the members of the organization as individuals and as members of regulatory bodies keep awake to the tendency and see to it that whatever legislation is perfected to help solve the problem be the result of experience and study. "We do not believe," said the report in conclusion, "that when a plant is taken over by a municipality it should be freed from the supervision now given privately owned plants. Rather, we believe that we should pay greater attention to the newly acquired municipal utility than to one privately owned, that it may be able to render that degree of service which the people expect and to which they are entitled."

ECONOMY IN USE OF WATER POWER FOR TWIN CITIES

Result of Study Made During the War by the Fuel Administration and Power Section of War Industrial Board

The United States Fuel Administration and the power section of the War Industries Board, desiring information during the war regarding what economies in coal consumption could be realized by the further substitution of water power in the cities of St. Paul and Minneapolis and adjacent territory, had a report prepared by W. G. Hoyt, of the Geological Survey, and F. W. Huels, engineer Wisconsin Railroad Commission, showing such data. This report has just been made public by the Geological Survey.

Particular attention was given in the survey to the increase in the amount of water power which could be furnished by the development of the Pa Kwa Wang storage reservoir and the construction of the Jim Falls hydroelectric plant, and also including the power which could be obtained from the Government High Dam on the Mississippi River between St. Paul and Minneapolis.

As a result of the investigation it was concluded that there was a power shortage in St. Paul and Minneapolis and that this shortage would continue until the 25,000-kw. steam turbine and generator, then under construction, should be in operation. Other conclusions developing out of the investigation were as follows:

The total 1918-19 demands of St. Paul, Minneapolis and vicinity are 354,000,000 kw.-hr.

The coal saved by the generation of water power for use in St. Paul, Minneapolis and the immediate vicinity should be computed on the basis of 2.5 lb. of coal per kilowatt-hour.

The development of the Government High Dam would replace 41,700,000 kw.-hr. in the Twin Cities. The development of the Pa Kwa Wang and Jim Falls would replace 29,200,000 kw.-hr. in the Twin Cities and Winona.

On the basis of coal consumption in the Twin Cities, not including coal required to transport coal, the development of the Government High Dam would replace 52,000 tons of coal and the development of the Pa Kwa Wang storage reservoir and the Jim Falls hydroelectric plant would replace 36,500 tons of coal.

Economically the storage reservoirs at the headwaters of the Mississippi River are more valuable for power than for navigation.

The average for 1917 shows that 66 per cent of the total power was generated by water power and 34 per cent by steam. For the first six months of 1918 these proportions were 73 per cent water power and 27 per cent steam.

Storage reservoirs on the Chippewa River would materially cut down coal consumption during the low-water months without creating a surplus during the high-water months.

The report contains maps and diagrams showing the

power production of operating companies in the district. It also describes the existing and prospective load conditions, load curves, the efficiency of power stations in the utilization of fuel, the utilization of water power and the use of exhaust steam for heating.

The report will not be printed and is not available for general distribution, but it may be consulted at the office of the United States Geological Survey, Washington, D. C., or the district office of the survey, care of the Railroad Commission of Wisconsin, Madison, Wis.

POST-WAR CONSTRUCTION IN THE BOSTON COMPANY

War-Time Policy of Conservation, Though Not Entirely Done Away With, Does Not Largely Interfere with Extension of Business

In the annual report to stockholders for the year ended June 30, 1919, Charles L. Edgar, president Edison Electric Illuminating Company of Boston, says that the policy of conservation in construction continued in force until some months after the armistice was signed.

"During the last three or four months of the year, however," Mr. Edgar added, "this policy was made much more liberal, and although it is not yet back to the conditions which existed before the war, it is at a point where it is not materially interfering with the extension of the company's commercial business."

Mr. Edgar divides the increases in revenue and expenses so as to show those which are normal and those which resulted from the unusual conditions prevailing.

"The increase this year of approximately 43,000 kw., or over 12 per cent, is very satisfactory," he said. "This includes 12,500 kw. for the Quartermaster's Terminal in South Boston, a strictly war project, but of the remainder by far the larger part has been added since the signing of the armistice, showing that this year's growth is more largely of the normal commercial character than due to war activities. The termination of the war, therefore, seems to have had no unfavorable effect.

"The very large increase in gross earnings of $1,812,000 is due not only to the normal increase in business but to a 10 per cent addition to all bills for electricity, which became effective in December, and to a charge during a portion of the year, based upon the kilowatt-hours used by each customer, of an amount equal to the difference between the present cost of coal and the cost under pre-war conditions. These two items alone amount to approximately $1,116,000, leaving $696,000 representing the normal increase in earnings.

"Expenses likewise have greatly increased—$1,456,000. The excess cost of coal for the year over pre-war cost amounted to $1,145,000 and is $682,000 more than it was for the previous year. In order to meet partially the increased cost of living, an increase of 10 per cent in the pay of all employees receiving $3,000 or less was put into effect in May of 1918. This was increased to 25 per cent early in July of 1918 and has been in effect during the remainder of the fiscal year. This item amounts to approximately $450,000. These two items have therefore increased the expenses $1,132,000, leaving $324,000 as the normal increase in expenses.

"The two items of earnings, amounting to $1,116,000, and the two of expenses, amounting to $1,132,000, have therefore very nearly counterbalanced each other."

INVESTMENT BANKERS NEED THE CONSULTING ENGINEER

Council of American Institute of Consulting Engineers Points Out Importance of Investigation Before Foreign Investment

The council of the American Institute of Consulting Engineers, Inc., has sent a letter to investment bankers of New York and other cities urging that they retain consulting engineers in the same manner as is done in Great Britain. This suggestion is of special importance at present because of the evident tendency of American capital to seek investment in foreign fields. The council says:

In this country consulting engineers are usually retained to make a report on a property, which, if favorable, is frequently used with a circular soliciting a subscription to bonds, and the services of the engineer have generally been dispensed with on the completion of such report. In Great Britain it is precisely at this point that the work of the consulting engineer becomes of greatest aid. It would there be considered very unbusinesslike if a banking house or syndicate, after disposing of bonds that have been underwritten by it, should fail to supervise properly the ultimate disposition of the funds advanced the enterprise by retaining competent engineering advice to see that the expenditures are made in accordance with the terms of the indenture and to make sure that the property is at all times efficiently managed. Yet this failure to utilize independent and experienced engineering talent is the exact custom of many American bankers and investors.

The result has been frequent disappointment to investors, with the subsequent criticism of the banking houses themselves. It is likewise true that bankers have lost clients by reason of losses resulting from this lack of experienced technical supervision.

The members of the institute are alive to the present condition of international affairs which has placed this country economically at the head of the society of nations. The war has left us the only creditor nation. Large financial demands will be made upon this country, through its principal bankers, for capital to be used in the rehabilitation of some of the nations that have been at war and for the funds necessary to develop those countries heretofore dependent upon capital from Great Britain, France and Germany. These developments have ceased during the past four years but must in some manner be undertaken now by the United States bankers. It is believed that Great Britain will not be able to do more than support the capital already invested in her own colonies. American investors will continue to be reluctant to invest in railroad and other public service utilities in this country until a more definite and safe policy is adopted by our government. They must find an outlet for their idle capital abroad.

The council of the Institute invites the attention of bankers to the evident wisdom of their adopting the practice of retaining independent engineering counsel and advice before investing funds in foreign government or corporate securities and suggests that, if bankers make such investments, experienced engineers should also be retained to supervise the expenditures and to see that the capital so employed is properly managed.

The council feels that it is performing a public service in inviting the attention of bankers to the above facts, but claims no altruistic or unselfish aim in making these suggestions, as it is actuated by the desire to call attention to the fact that the institute has among its members leading engineers specializing in all branches of the profession. They are ready in a purely professional capacity to assist the banker and to lend their advice and undertake the supervision of management in the same manner as the consulting engineers of Great Britain do for the public and banking institutions of the British Empire.

Lewis B. Stillwell is president of the institute, A. M. Hunt is vice-president and F. A. Molitor secretary. The council is composed of Mr. Stillwell, Mr. Hunt, William J. Wilgus, J. Vipond Davies, Philip W. Henry, Colin M. Ingersoll, J. Parke Channing, Desmond Fitzgerald, S. Whinery, Frank J. Sprague and George Gibbs.

FAVORS CONTINUOUS OPERATION OF ALL THE PUBLIC UTILITIES

Directors of Merchants' Association of New York Request United States Chamber of Commerce to Draft a National Law

Directors of the Merchants' Association of New York have adopted a resolution favoring the principle of continuous operation of public utilities. It requests the United States Chamber of Commerce to take a referendum vote of its members and, if approved, to draft a bill, to cause it to be introduced in Congress and to prepare a memorial for presentation to Congress and for general public distribution in support of the legislation. In drafting this bill the chamber is asked to co-operate with public service corporations, representatives of their employees and others whose counsel would be of service.

The resolution recites that the public welfare requires continuous and unimpeded operation of public utilities. It declares "that the tenure of service of employees of public service corporations, particularly of transportation corporations, should be regulated by law in such a manner that each person who voluntarily elects to enter such employment shall, as a condition of such employment, be legally obligated by contract to continue therein for a specified term, during which term he may not lawfully quit that employment nor the corporation lawfully discharge him from its service, except as provided by such contract; and that such contract should provide adequate penalties for violation of its terms by either party."

CENTRAL-STATION SERVICE IS URGED FOR BOSTON CITY HALL

Finance Commission Investigation Indicates That Saving Would Come from Shutting Down Isolated Plant

The Boston Finance Commission, an advisory body charged with frequent investigations of municipal administration efficiency, has sent a report to Mayor Peters recommending that the isolated plant in the City Hall Annex be discontinued and that electrical energy for furnishing light and power for the City Hall and for the City Hall Annex be purchased from the Edison Electric Illuminating Company of Boston. At the time of the construction of the Annex the commission recommended the use of Edison service, but the recommendation was not accepted. The present report follows a recent request of Mayor Peters that means of reducing municipal expenditures be investigated.

An examination of the cost of operation of the plant at present shows that with the present cost of coal and the present wage scale a saving of more than $4,000 a year could be effected by shutting down the 312.5-kw. isolated plant in the Annex and purchasing Edison service. This would require the reduction of the engineering force by the elimination of two assistant engineers and three firemen, one-half of whose time is now charged to the engine room. A further saving of $2,500 could be made if the city installed new electric elevators in the City Hall to supersede the present hydraulic elevators, which are operated by steam-driven pumps. These elevators are old and constantly out of repair. The commission is of the opinion that two new electric elevators could be installed for $20,000. The fixed cost for interest and carrying charges on the investment would be about $1,500, and the saving in operating cost about $4,000, leaving a net saving of $2,500.

The commission points out that if it is found inadvisable to install new electric elevators, two alternatives will accomplish the same financial saving, though they will not improve the service to the same extent as a complete electric installation. The first alternative would be to install electrically driven pumps at a cost of about $5,000 to replace the existing steam-driven pumps. The second would be to install one electrically driven pump for five months of summer service, using the present steam pumps in winter. This would cost about $3,500. The commission recommends, besides providing for Edison service, that a detailed study be made of the best method of changing the motive power of the elevators from steam to electricity.

Electrical energy for lighting, for six electric elevators and miscellaneous power is now produced by generators of 312.5-kw. rating upon the premises. Steam is used for heating and for steam pumps serving the two hydraulic elevators in the City Hall.

The Edison company's report, signed by J. F. Wanles of the commercial engineering division, compares the present cost (1) of light, heat and power and those costs which would result if the electric generating plant were shut down and electrical energy purchased and used under either of two different systems of operating; (2) Edison service with two hydraulic elevators; (3) Edison service with all electric elevators.

The total yearly costs are summarized as follows:

(1) Present cost of operating plant.....	$36,710
(2) Cost, Edison service, two hydraulic elevetors	32,232
(3) Cost, Edison service, all electric elevators	28,463

It appears that a saving of over $4,000 per year is possible by simply shutting down the small engine-driven generators and buying electricity. This change involves no investment on the part of the city other than the cost of installing the cable from the switchboard to the Edison service terminal. The saving will be increased to over $8,000 per year provided the two hydraulic elevators are electrified so that the boilers may be shut down during the non-heating period. The electrification of the two remaining hydraulic elevators may be considered a permanent building improvement rendering superior and more reliable service than that possible with the old hydraulic equipment.

From the records of several steam heating plants in Boston, the amount of coal burned during December, January and February averages a total of 54 per cent of the seasons's coal requirement. The total coal burned at the City Hall during these three months last year, covering electric plant and hydraulic elevators, was 599 tons. Assuming that only 10 per cent of this could be saved without the isolated plant generators during these three months, 540 tons remain and represent 54 per cent of 1000 tons of coal to be charged yearly to heating the building.

The amount of coal required to operate two hydraulic elevators during the summer months is taken as 22 tons per month, based upon actual experience in several buildings using Edison service and having hydraulic elevators. The amount of coal chargeable to hydraulic elevators at City Hall, due allowance being made for exhaust steam for heating, is as follows: Six summer months at 22 tons, 132 tons; six winter months at 10 tons, 60 tons; total 192 tons. Hence 1200 tons was taken as a conservative estimate of the total for elevators and heating.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

ELECTRICAL SHOW FOR WORCESTER, MASS.—The first annual electrical show in central Massachusetts will be held at Worcester, Mass., Nov. 29 to Dec. 6. Prominent Boston jobbing and manufacturing interests, as well as local electrical concerns, will exhibit.

ENGINEERING COUNCIL INDORSES PUBLIC WORKS DEPARTMENT.—The Engineering Council indorses the establishment of a national Department of Public Works as a wise and necessary initial step in the correction of faults of administrative organization in the federal government.

CLEVELAND ELECTRICAL ENGINEERS ACCEPT CO-OPERATION PLAN.—The Cleveland Section of the American Institute of Electrical Engineers has accepted the plan of the Cleveland Engineering Society for co-operation in an effort to obtain for the benefit of all local engineers the information developed at the meetings of either society. The meetings of each organization are now open to the membership of the other.

MR. MCCALL'S OFFER FOR OPERATING ECONOMY PAPER.—President Joseph B. McCall of the Philadelphia Electric Company has renewed an offer of $50 gold to the Philadelphia Electric Company section for the best paper of the year pertaining to improvements in operating economy. It is not intended that this paper should be a technical discussion full of higher mathematics, but rather the presentation in simple English of an idea developed sufficiently to show that its application will result in a reduction in operating costs.

CALIFORNIA MERGER PROMOTES DEVELOPMENT.—Hydroelectric development in California was given a decided impetus by the Railroad Commission when it approved the purchase of the properties of the Northern California Power Company by the Pacific Gas & Electric Company. Approval of this transaction by the commission, in addition to making possible a merger of power properties that will prove of great benefit to the state, will prevent threatened litigation that promised to block for years needed hydroelectric development. Its immediate effect will be to make possible the development of the Pit River project, a gigantic power scheme held in abeyance by the Pacific Gas & Electric Company because of threatened war with the Northern California Company over water rights. The commission definitely disposed of the charges of fraud made by Walter Perry Johnson and W. F. Hubbard, representing minority stockholders, who opposed the transfer of the properties, by declaring that the evidence taken at the hearing of the application for approval of the sale "utterly failed to establish fraud" but on the contrary showed that the transaction was the result of open bargaining devoid of collusion, in which the interests of the stockholders of the Northern company were well protected.

GOVERNMENT PLAN FOR RADIO CONTROL.—A new policy for control and development of radio communication has been submitted to Congress by Secretary of the Navy Daniels. It provides for maintenance of both naval and private stations, with the latter under control of a national radio commission, and proposes to open existing or new stations to general public correspondence at rates to be fixed by the Navy Department and Congress. General public transoceanic correspondence through naval stations would not be permitted, however, except during temporary suspension of private service.

NEW SOUTHERN STATION.—Owing to new business which has been acquired lately by the Appalachian Power Company, it has had to extend its Glen Lyn (Va.) steam station, which was described in the Jan. 18, 1919, issue of the ELECTRICAL WORLD, and install an additional turbo-generator rated at 20,000 kva. Including the condenser, auxiliaries and the small amount of electrical equipment required for this addition, the cost of the extension will be about $750,000. The station with its new addition will be rated at 40,000 kva. and is connected with several hydroelectric and other steam plants.

AMERICAN ELECTROCHEMICAL SOCIETY ACTIVITIES.—Joseph W. Richards, secretary of the American Electrochemical Society, spent the summer in Sweden and Norway and returned interested in the possibility of a meeting of the society in connection with a tour of those countries in 1921 or 1922. The Southern Appalachian trip showed the ability of the society to make a successful meeting tour, and a similar one to Scandinavia is well within the possibilities. The board has directed the secretary to find out all he can about such a possible trip. The board has indorsed the principle of a national Department of Public Works. It has also authorized President Bancroft to appoint a committee to draft a resolution protesting against the abolition of the Chemical Warfare Service.

N. E. L. A. COURSES OPEN TO ALL.—The National Electric Light Association has opened for subscription all of its educational courses at the association prices to whomsoever wishes to subscribe. Up to the present time subscriptions, have been confined to its members, but owing to the continued demand from allied industries, colleges and schools for use of these courses, the public policy committee and the executive committee have approved a resolution opening subscriptions to all who may apply, believing that a wider distribution of these courses would be of general benefit to the industry as a whole. The courses are four in number: the course in practical electricity and the commercial engineering course, both published by the Commercial Section; the elementary accounting course, and the advanced accounting course published by the Accounting Section.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

A. I. E. E., CLEVELAND SECTION.—This seition of the American Institute of Electrical Engineers is to change its meetings to the third Tuesday of each month.

DALLAS JOVIAN LEAGUE.—This organization has recently by amendment of its constitution opened its membership to architects and to building contractors. The league invited to its regular lunch on Oct. 20 the architects and contractors of the city, and the idea was proposed and committees were formed to carry out the plan of co-operation into actual practice.

A. I. E. E., BOSTON SECTION.—W. C. Slade, superintendent of power and lines, Rhode Island Company, Providence, R. I.; L. B. Bonnett and C. M. Gilt of the General Electric Company, Schenectady, N. Y., and C. A. Butcher of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. discussed "Automatic Substations in Theory and Practice" at the Oct. 14 meeting of the section.

A. I. E. E., SCHENECTADY SECTION.—Dr. Charles P. Steinmetz, consulting engineer of the General Electric Company, spoke on "Technical Education" at the Oct. 17 meeting of this section of the American Institute of Electrical Engineers. The historical development of technical education in the United States was discussed, and it was shown how the close co-operation of educational institutions with industrial corporations has been largely instrumental in the rapid advance of technical education in those branches of engineering where such co-operation was most marked, as in electrical engineering. The two viewpoints of technical education were discussed, that of laying most stress on strictly professional training and that of demanding a broad general education as a foundation for specialization.

INDIANA STATE ASSOCIATION OF ELECTRICAL CONTRACTORS.—"The Heating Device License Schedule," by Charles A. Payne; "Live and Help Live," by Samuel Adams Chase of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.; "The Work of the National Association," by W. H. Morton, New York City, general manager of the National Association of Electrical Contractors and Dealers, and "Electrical Merchandising Address and Exhibit," by William L. Goodwin, of the General Electric Company, New York City, were some of the important addresses at the annual convention of the Indiana State Association of Electrical Contractors, held recently at Indianapolis. G. M. Sanborn of Indianapolis and A. B. Harris of Gary were elected members of the state association's executive committee. and A. L. Swanson of Evansville was elected chairman.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

RULES AGAINST LOW RATES TO CHURCHES.—In a decision affecting the town trustees of Warren, the Indiana Public Service Commission ruled that it is discriminating for a utility to charge lower rates to churches and eleemosynary institutions than to other consumers. The case went before the commission on the petition of the Warren municipal utility for an increase in electric rates. The municipality was ordered to add a surcharge of 1 per cent per kilowatt-hour to its regular rate and to increase its minimum charge per month from 50 cents to 75 cents. The commission found that the town had been furnishing energy to churches and a charitable institution at 5 cents per kilowatt-hour, a rate much lower than its rate to other consumers for rendering the same service, and it disapproves of this discrimination being made.

DEPOSIT FOR EXTENSION NOT REQUIRED.—The Illinois Public Utilities Commission has sustained a complaint against an electric company for refusal to furnish service for elevator motors without a deposit covering the cost of additional equipment necessary therefor. It ordered the Central Illinois Public Service Company to furnish the required service to the Farmersville Coöperative Elevator Company. The commission held that a deposit to cover the cost of additional equipment necessary to enable a utility to render the service demanded cannot be required, under the Illinois statutes, where similar deposits are not required as a condition precedent to rendering similar service and where the schedules of the company contain no provision for such a deposit. Additional facilities necessary to enable an electric utility to supply energy for elevator motors were considered as an extension of service within the Illinois commission's Rule 31, authorizing utilities to require a deposit of the cost of extensions beyond the free limit.

STOCKHOLDERS NOT ENTITLED TO REDUCED RATE.—The Missouri Public Service Commission, in a case affecting the Salem Light & Power Company, held that it is unlawful discrimination for a company to sell utility service to its stockholders for less than the rates charged to the general public. It says in part: "The company has followed the practice of selling electric energy to its stockholders at the rate of 5 cents per kilowatt-hour, while all other consumers paid the rate of 15 cents per kilowatt-hour. The present rates for residence lighting are 15 cents for the first block and 12 cents per kilowatt-hour for commercial lighting. The testimony showed that the company had no consumers who used more than the first block, and therefore all paid the initial rate. On request, at the time of the hearing, the company agreed to furnish the commission information as to the amounts charged its stockholders and what such charges would have been if such service had been charged for at the same rate that the other consumers are charged. This information discloses the fact that in the year 1918 stockholders paid $62.20 at the 5-cent rate, and that if charged the 15-cent rate they would have paid $186.60, or additional revenue in the sum of $124.40."

LOSS IN TRANSMISSION UNDER CONTRACT.—Authorizing an increase in rates charged by the Orleans Electric Light & Power Company to the Orleans Water Company, the Indiana Public Service Commission held that an agreement as to rates made since the passage of the Public Service Commission act is not valid unless approved by the commission. The commission says in part: "The evidence shows that the energy furnished to respondent is measured at the pumping station after its conversion from direct current to alternating current and its transmission over a transmission line from the plant to the pumping station, a distance of a little less than a mile. The motor-generator, which has a capacity equal to the maximum demand at times of fires, or when the demand for water would be greatest, operates on light load most of the time, and this is largely responsible for the tremendous loss in energy from petitioner's switchboard to the pumping station. The evidence shows the loss in 1918 to have been 62.2 per cent. Petitioner seeks to establish a rate of 4 cents per kilowatt-hour for energy furnished respondent, measured at petitioner's switchboard, whereas the actual cost of producing the same, making no provision for depreciation or return on investment, is 0.0426 cent per kilowatt-hour. The evidence warrants a rate considerably in excess of 4 cents and under normal conditions would be accorded its full significance by the commission. The cost of producing energy may be expected to recede somewhat within the next year or two, however, and within that time petitioner may be able to make a small profit at 4 cents per kilowatt-hour. Moreover, a 4-cent rate at petitioner's switchboard will be equal approximately to an 11-cent rate at the pumps of respondent, which is an extremely high rate. It is doubtful whether the respondent would be able to obtain the service more cheaply, though it may be presumed it will do so if that is possible. There is no merit in respondent's contention that equipment installed by it to make the energy produced by petitioner available should be considered in fixing a rate to be paid, since a rate of 4 cents is below the cost of production before the energy reaches this equipment, and because, moreover, the equipment is used only to furnish service to respondent and, so far as petitioner is concerned, is valueless for any purpose. The commission is of the opinion that if the Orleans Water Company will install a motor-generator for converting direct into alternating current more nearly in accordance with the average load to be carried, the tremendous loss occasioned by the operation of the present motor-generator in use will be greatly diminished. The present generator," the commission points out, "may be held in reserve for use in emergencies."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

CONTRACT WITH MUNICIPALITY.—While a city council cannot bind its successors in the exercise of the police power, it can, when properly authorized, make a contract for the rendering of public service by corporations in which the rates to be charged are fixed, which contract is no more subject to impairment than the contract of individuals. (City of Watertown versus Watertown Light & Power Company, 173 N. W. 739.)

CONTRACTS MADE AFTER ENACTMENT OF UTILITIES ACT MUST NOT CONFLICT WITH COMMISSION'S RATES.—The public utilities act was passed June 14, 1911, and any contract for service entered into by a public utility and a patron subsequent to that date is subject to the supervision of the Public Utilities Commission and is not binding and enforceable in so far as it conflicts with the rates established through the commission. (Patterson Foundry & Machine Company versus Ohio River Power Company, 124 N. E. 241.)

ACTION FOR DEATH OF CITY FIREMAN.—That the insulation of wires soon deteriorates under action of sun and rain, making it impossible to keep them safe, and that the purpose of insulation is not protection but to prevent wasteful escape of the fluid, were held not to be good defenses in action against an electric company for death of a fireman killed by contact with its wires while climbing a ladder to aid in fighting a fire. Such a man was not a mere licensee as to the electric company occupying with its wires the public street, but was engaged in the performance of a public duty and entitled to protection. (City of Shreveport versus Southwestern Gas & Electric Company, 82 S. 785.)

POWER OF MUNICIPAL COUNCIL TO FIX RATES.—The council of a municipality has authority to fix the price that an electric light company may charge the city or its inhabitants for electrical energy for light and power purposes. Where the price of such electrical energy for light or other purposes is fixed by ordinance for a period not exceeding ten years and the electric light company files in the office of the auditor or clerk of the corporation its written acceptance, such ordinance and acceptance in writing constitute a contract between the municipality and the electric light company binding on both parties thereto during the term named in the ordinance. By the provisions of the General Code such contracts are specifically exempted from the operation of the statutes of the state defining the powers and duties of the Public Utilities Commission of Ohio in relation to the rate that such public utility may charge for any service rendered or to be rendered by it. (Ohio River Power Company versus City of Steubenville, 124 N. E. 246.)

CARROL G. BROWN, for the past four years professor of electrical engineering at Cornell, has joined the staff of the School of Engineering of Milwaukee.

GEORGE MCKENZIE, who has been local superintendent of the Mystic (Conn.) Power Company for the last five years, has resigned. Harry Anderson succeeds him as local superintendent.

R. H. PHILLIPS has been appointed superintendent of the water power and steam station of the Defiance Gas & Electric Compuany near Maumee, Ohio, succeeding his brother, J. E. Phillips, who recently died.

D. F. MCCURRACH, chief engineer of the state Public Service Commission, Olympia, Wash., has resigned and Capt. Herbert J. Flagg of Seattle has been appointed to succeed him. Captain Flagg since his return to civil life has been appraisal engineer for the Public Service Commission.

B. H. GARDNER, for the past two years manager of the New Britain district of the Connecticut Light & Power Company, has been appointed sales manager of the company, with headquarters at Waterbury. H. S. Franklin, assistant superintendent at New Britain, has been appointed local manager in place of Mr. Gardner.

JOHN H. ANDERTON, who during the war period was chief electrical engineer for the American International Shipbuilding Corporation at Hog Island, is now in active charge of the electrical engineering work on the new Caribou hydroelectric installation of the Great Western Power Company in the Sierra Nevada Mountains of California. Mr. Anderton has recently taken up his residence in San Francisco and expects to maintain his headquarters in that city for a number of months to come.

E. E. YENSEL, vice-president and general manager of the New Jersey Power & Light Company, Dover, N. J., has resigned to become manager of the American Auto Supply Company of Chicago, Ill. Mr. Yensel previous to his connection with the New Jersey Power & Light Company had charge of a great deal of new development and construction work, including the building of power plants and transmission lines to serve the iron mines and industrial plants. Before going to Dover Mr. Yensel was manager of the Easton (Pa.) Light & Power Company.

A. H. FORD has resigned as vice-president and general manager of the Cumberland County Power & Light Company, Portland, Me. and acquired an interest in the firm of Hamilton & Wade, Inc., New York City, insurance brokers and engineers. Mr. Ford is one of the best known public utility executives in the East and for many years has been actively identified with the management of electric railway, lighting and power companies. Before going to Portland he was manager of the Birmingham (Ala.) Light & Power Company. His constructive work in the field of public relations, progressive commercial and sound engineering development of properties in both electrical railway and central-station fields has been felt far beyond the confines of his immediate posts.

Men of the Industry

Changes in Personnel and Position— Biographical Notes

JOHN B. FISKEN, chief engineer of the Washington Water Power Company of Spokane, Wash., who was recently elected president of the Northwest Light and Power Association, has been closely identified with the development of the electrical industry of the great Northwest since 1886. Born in Scotland in 1861, Mr. Fisken received his technical education in Glasgow and London, but went to the Pacific Coast soon after. Following electrical engineering experience in Seattle, Wash., and in Victoria and Vancouver, B. C., he went to Spokane, where he has aided in the upbuilding of the industry for thirty-two years. For many years he has been associated with the Washington Water Power Company, attaining the position of chief engineer in 1918. His important post with that company has made him acquainted with a broad field of activity, including engineering, construction, maintenance and operation. Mr. Fisken has for a number of years served as a vice-president of the American Institute of Electrical Engineers, and he acted as chairman of the recent Pacific Coast convention of the Institute, which met at Los Angeles during September. His election to the highest office in the Northwestern association is a fitting recognition of his loyal services to the several branches of the industry.

JOHN B. FISKEN

F. A. KARTAK, who has been director of the standards laboratory at the University of Wisconsin for a number of years, has left that post to become professor of electrical engineering at the School of Engineering of Milwaukee. The great usefulness of the standards laboratory to the electrical utilities of Wisconsin has been largely due to the efforts of Professor Kartak.

E. L. WHITE, formerly new-business manager of the Reading (Pa.) Traction & Light Company, will succeed E. E. Yensel, who resigned as vice-president and general manager of the New Jersey Power & Light Company, Dover, N. J.

M. H. MAHONEY has resigned as superintendent of the Franklin Electric Light Company, Turners Falls, Mass. Mr. Mahoney is succeeded by Charles E. Bankwitz, formerly with the Pennsylvania Water & Power Company, Holtwood, Pa.

EBEN F. PUTNAM has been appointed superintendent of the Norwalk (Conn.) branch of the Connecticut Light & Power Company, succeeding the late Stanley H. Smith, and has entered upon his new duties. He was formerly superintendent at the Greenwich (Conn.) branch.

HENRY I. HARRIMAN, president of the New England Power Company, was recently presented by the directors of the Boston Chamber of Commerce with a sun dial resting on an Italian-carved shaft in appreciation of his services during his recent two years' administration as president of the chamber.

J. E. NORTH, who for several years was commercial manager for the Springfield (Ohio) Light, Heat & Power Company, and who later was connected with the Chamber of Commerce of Springfield, has been made publicity manager for the Cleveland Electric Illuminating Company of Cleveland, Ohio.

O. A. JENNINGS, formerly manager of the oil-field electrification department of the Oklahoma Gas & Electric Company, has been appointed manager of the commercial department of the company with supervision of its commercial activities throughout the State of Oklahoma. Mr. Jennings is stationed at Oklahoma City.

G. H. CLEVENGER, heretofore vice-chairman of the engineering division of the National Research Council, with offices in New York, has given up active supervision of the work of the council to fill a professional engagement in Mexico. Upon his return some months hence he will open an office in New York City as consulting engineer, specializing in metallurgical lines.

E. H. MARTINDALE, who for a number of years has been sales engineer with the National Carbon Company at Cleveland, Ohio, has resigned to devote his entire time to the affairs of the Handy Supply & Manufacturing Company of that city, which was organized by him a few years ago. Mr. Martindale is president and general manager of that company, which furnishes supplies needed by industrial plants and electrical repair shops. Mr. Martindale is a manager of the A. I. E. E. and has served on important committees. He has devoted a great deal of time to the study of industrial-plant motor problems, particularly those in connection with commutation. During the war he was a captain of engineers in service overseas.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

JAPANESE SUPREME COURT UPHOLDS U. S. TRADEMARKS

Broad Decision of Much Interest to Electrical Manufacturers in Competition with Japanese Goods in Foreign Trade

The Supreme Court of Japan, in a suit instituted by an American manufacturing company for the protection of its trademark rights, has handed down a decision which in unqualified terms upholds every essential of trademark rights guaranteed under Japan's treaty agreement with the United States. In the case in question the American concern had a scroll with its name "Miller" inside. The Japanese infringement was a scroll with the name "Million" inside. The litigation was a fight for the essential principles underlying trademark treaty rights.

During the past twenty years every trade and commercial body of the world has been confronted with a rising tide of Oriental imitations of widely known, high-grade Occidental products. Electrical products have come in for their share of imitation, particularly wire and cable in the Australian market. It made little or no difference, apparently, whether or not the article imitated bore a trademark. But wherever it was trademarked the injury inflicted by the imitation was doubled, because a very high proportion of the good will constituting the value of the specialty was not only utilized as stolen capital by the common trade enemy but was, at the same time, lessened in value by the substitution of the inferior for the superior article, with inevitable injury to the reputation and good will that had been established on the basis of quality and trademark publicity.

To the present decision, therefore, there attaches an unusual significance, especially for American electrical concerns engaged in foreign trade.

HEAVY BUYING SLOWS UP GLASSWARE SHIPMENTS

Although Prices Have Remained Steady for Some Time There Is a Feeling that Imports for Europe May Force Revision Downward

Electrical glassware factories are getting further and further behind on shipments as a result of the continued strong demand and the labor shortage.

It was expected in some quarters that after the customary summer shut-down for inventory and repairs to furnaces manufacturers would be required to pay higher wages. As far as could be learned, however, there has been no general demand for an increase, and as a result there has been little rise in price of glassware since the resumption of work. Nevertheless, labor is not satisfied, and there are fears expressed that it will make demands which if granted will substantially increase the price of glassware. Where a consumer is able to place a large order directly with the factory glassware prices are holding very steady, but where the consumer needs only a small amount he will probably find a price slightly higher than that which was in effect during the summer.

Orders for large amounts of lighting glassware are coming into the factories in such good volume that deliveries in some cases are as long as four months. On simple glassware in small lots shipments are nearer two to three months. Where only a small amount of a certain type is ordered it is becoming more customary for manufacturers to hold up the order in hope that the customer will find a demand for a sufficient amount of that class of material to make it pay him to run a big order through the factory. Frequently the customer is prevailed upon to substitute other glassware which might be easier to produce.

One factor which will probably have considerable bearing in the lighting-glass market is the importation of glassware from Austria, Germany, Belgium and France. Although at the present time little import business is being done in this glassware, it is looked forward to as one of the means through which domestic prices will be lowered. It is not an unknown feeling throughout the retail trade that lighting glassware prices are too high, and this feeling has been expressed in the desire for foreign competition in order to bring prices down to what is believed to be a more normal basis. Some manufacturers, on the other hand, are of the opinion that prices of domestic glass have reached their limit and that next year may see a reduction. An especially good year is looked for next year in the lighting fixture and glass business, and if sufficient labor can be gathered for producing it it is possible that through this higher production and increased buying lower prices may result.

WAR STANDARDS IN FANS CONTINUED IN 1920 STYLES

Predicted that Sales Next Year Will Be 25 per Cent Greater than This Year in Spite of Expected Increases in Price

During the war fan manufacturers, in co-operation with the War Industries Board, discontinued certain sizes, styles and refinements in electrical fans which conditions of the past year seemed to justify. At that time odd sizes were manufactured and stocked and special finishes and lengths of cord were produced which catered only to a special trade. During the first year following the close of the war these efforts toward standardization proved themselves to be so effective through the large increase in volume of sales for the season 1919 that the tendency of fan manufacturers for the season 1920 is to hold the advantage they have gained by concentrating production on fewer types and styles, uniform finish, length of cord, etc.

As far as can be learned at this time six-blade fans will not be stocked or listed. Rather will efforts continue to be directed toward the 12-in. and 16-in. four-blade alternating-current and direct-current oscillating and non-oscillating fans. These four types in the two larger sizes, namely, 12 in. and 16 in., enjoyed vastly increased sales during the past year, and conditions point to a still further increase next year. The 9-in. and 10-in. fans will appear in both oscillating and non-oscillating for alternating and direct current, while the 8-in. fans in general will be non-oscillating. This does not mean that manufacturers will not fill orders for special fans, but that the sizes kept in stock and listed will be those which have been given above. The same applies to finish and other refinements, because it is realized that stock equipment and finish could not always be employed in connection with certain decorative schemes.

As to ceiling fans, a four-blade fan with 56-in. spread plain type and one finish will probably be listed and stocked more generally than any other type and size. Certain manufacturers, however, have their own special designs on ceiling fans, and it is reasonable to suppose that some of these will be listed and placed in stock.

Both 12-in. and 16-in., four-blade and six-blade, alternating and direct current ventilating fans will be given much attention by the producers.

The conservation program will be continued this year in the steel blade and black guard. In general the finish of the fan will be black enamel, because up to date the colored finishes have not as a rule proved sufficiently satisfactory to warrant their continuance. Here, again, however, special finishes will undoubtedly be supplied where required. While some distributers have recommended a 10-ft. cord, the general belief seems to be that the 8-ft. cord in the majority of installations is sufficient. Separable plugs will be used.

When the price of fans took such an increase last year many distributers were rather pessimistic as to what the outcome would be. The season closed, however, with shelves throughout the country virtually wiped clean of fans. During the past year prices of materials have advanced and the labor market has been constantly increasing and is very unsettled, so that a further advance over last year's price will probably be announced before the end of this year. The advance, therefore, should be somewhere around 12 to 15 per cent above 1919 prices, and a big increase in sales is predicted.

The domestic market can hardly be said to be anywhere close to saturation. In fact, judging by the manner in which factory operators demanded fans during the past season and the increasing readiness of the average workman to purchase what has come to be more a necessity than a luxury, a fair estimate of the increased sales next year would be in the neighborhood of 25 per cent.

COAL STRIKE AFFECTS OIL-ENGINE MARKETS

Market Good in Dakotas, Minnesota and Kansas, with Numerous Orders from All Territories as Coal Difficulties Become Apparent

Manufacturers of internal-combustion oil engines have been enjoying an excellent business from small electric light and power companies in the states of Minnesota, North and South Dakota and Kansas and from mining properties in other states. This business usually originates with municipalities which have found it impracticable to secure service over a transmission line. The great distances between towns and the small sizes of the towns in these territories are usually determining factors in their inability to get high-tension transmission service. The deliveries on machines for this class of service have been good. A typical unit is an 80-hp. engine, and in some cases such units have been delivered out of stock from the branch stores of companies making oil engines. At most, deliveries of thirty to forty days are quoted. Prices on such equipment range from $5,000 to $6,000, depending on the type of service for which the engine is designed.

With the announcement of the miners that there would be a coal strike, some of the oil-engine builders in the Middle West experienced a flurry of orders for small oil engines to take the place of coal-fired boilers which were being used on more or less temporary work. Investigation seemed to show that these power users had been thinking of changing over to oil-engine drive on account of the cost of coal and that the added difficulties of the strike were the only things needed to create the impulse to act.

To take care of this increased demand one manufacturer is making a million-dollar addition to his manufacturing plant to produce more oil engines.

LIGHTING-FIXTURE SHIPMENTS LIGHTENING UNDER DEMAND

Manufacturers Generally Have Sufficient Supplies of Raw Materials to Last Them for Some Time as a Result of Forehanded Buying

Heavy buying has been responsible for somewhat larger shipments of fixtures but not to such an extent that it has affected the glass market. It is difficult to get even a small order of fixtures under one month, while six weeks will cover most orders. At the same time one manufacturer is up to three months. Labor is not only short but is very unsettled and produces less than it did formerly. Some manufacturers are in the throes of a strike, while others who have just escaped that crisis have acceded to the demands of the workers. In one outstanding case the adoption of a wage scale and profit-sharing system has kept labor at work.

Prices of electric lighting fixtures have advanced in the neighborhood of 40 per cent in the past year, of which 20 per cent has been added since the early summer. Although some manufacturers look for a possible higher price due to further unrest, it is the opinion in other cases that the peak has been reached. These advances have been laid entirely to labor as raw material prices have held very steady throughout the past two months.

There is really a shortage in nearly all lighting fixture materials. Although some silk-cord manufacturers have discontinued the manufacture, owing to the high cost of silk, many fixture manufacturers laid in large stocks during the period when this cord was plentiful and consequently are now well supplied.

A shortage of chain on current inquires is reported, but many fixture producers have chain on hand. It all seems to be a question of how forehanded the manufacturer of lighting fixtures was early this year in ordering raw materials which were short in the market during the war. Larger manufacturers have sufficient stocks of sockets and tubing. Some smaller producers have rather short stocks, and deliveries are lengthening.

Electrical supply jobbers handling complete lighting units are finding good sales for these products. The units are so standardized that quantity production has been easily attained, and manufacturers have been able to provide good stocks for large orders. When these fixtures are composed for the most part of glassware, the prices have remained rather steady, but where much metal work has been necessary there has been found a slight increase since summer. Those fixtures which may be adapted to different kinds of commercial and industrial lighting problems are in rather large demand because of ease of installing and immediate deliveries.

SEPTEMBER'S EXPORTS ARE JUST ABOVE YEAR'S LOWEST

The Total of $6,119,588 of Electrical Commodities Is 20 per Cent Below August but 19 per Cent Above August 1918.

Electrical exports for the month of September dropped to $6,119,588, which is next to the lowest month for the year. This was, however, a gain of 19 per cent over exports during the same month of 1918, although it shows a loss of 20 per cent from the August figures.

The total exports for the first nine months of 1919 amount to $68,439,204, which is a gain of about 55 per cent over the same period in 1918.

The only gains over August were in tungsten lamps and motors. Principal declines were shown in wire, fans, interior wiring supplies, telegraph and telephone apparatus and transformers, all of which were the lowest of any month this year.

The accompanying figures were compiled by the Bureau of Foreign and Domestic Commerce:

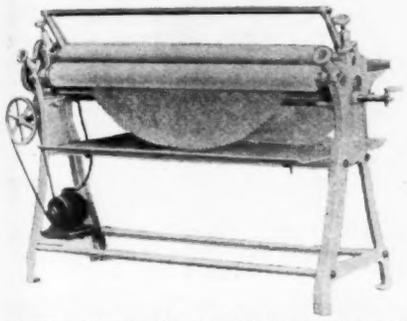
	September		Nine Mos. Ended	
	1918	1919	Sept. 1918	Sept. 1919
Batteries	$250,037	$442,588	$2,318,224	$4,606,809
Carbons	125,956	72,816	1,135,391	1,107,227
Dynamos or generators	269,276	525,040	2,464,929	4,145,933
Fans	26,396	49,768	707,663	1,240,808
Heating and cooking apparatus	48,552	91,881	470,784	1,187,296
Insulated wire and cables	548,640	301,315	4,214,489	7,292,707
Interior wiring supplies, including fixtures	88,139	146,729	1,091,379	1,730,529
Arc lamps	4,141	374	13,464	11,662
Carbon filaments	6,369	10,861	68,460	138,336
Metal filaments	282,518	358,396	2,524,412	3,774,211
Magnetos, spark plugs, etc	206,160	226,843	1,948,805	2,341,437
Meters and measuring instruments	100,301	208,496	1,462,320	2,269,620
Motors	589,905	733,891	5,489,651	7,845,643
Rheostats and controllers	12,993	38,326	167,578	375,116
Switches and accessories	162,049	339,188	1,711,966	2,771,659
Telegraph apparatus, including wireless	42,289	31,262	239,260	707,407
Telephones	228,961	199,986	2,228,807	2,691,137
Transformers	392,026	153,508	2,572,802	3,113,812
All others	1,761,369	2,188,370	12,926,567	21,087,862
Total	$5,146,077	$6,119,588	$43,756,901	$68,439,204

NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Motor-Driven Ironer with Two Rolls

The new type of motor-driven clothes-ironing machine put out by the Roma Manufacturing Company of Chicago is designed to iron all pieces of ordinary thickness at a speed of 8 ft. (2.4 m.) a minute in one passage under two steel rolls which are heavily padded with wool



CLOTHES IRONED IN ONE PASS THROUGH ROLLS

felt. The rolls revolve against a convex hollow steel shoe which is heated from the inside. Adjustable compression springs at each end of the rolls permit uniform pressure. All gears are inclosed and run in oil.

Washer for Raising Clothes Cylinder

An electrically operated clothes washer has been placed on the market by the Win-Her Washer Company of Des Moines, Iowa, in which the washing

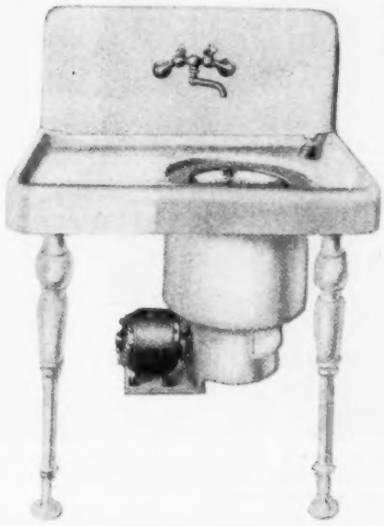
NO DIPPING OF HANDS IN HOT WATER TO REMOVE CLOTHES

cylinder may be swung up and allowed to rest out of the way when cleaning the drum or filling it with water. Moreover, the cylinder may be partly raised and locked in a convenient position above the water for putting in the clothes or for taking them out to be passed through the swinging wringer.

A swinging steel frame on which are hung the cylinder bearings is used to raise the cylinder from the drum. The new washer has a flexible double-belt drive.

Combination Electric Dishwasher and Sink

A vertical cylindrical electric dishwasher has been incorporated as a part of a kitchen sink and placed on the market by the Dunn Manufacturing Company of Chicago. The combination is made up of very few parts and is constructed of cast iron covered with porcelain enamel. Two perpendicular revolving paddles throw the water between the dishes, which



MAY BE USED FOR MAKING ICE CREAM

remain stationary, toward the center of the dishwasher. The motor can be used for making ice cream by replacing the dish frame with a special freezing can.

The domestic size outfit is operated by a ¼-hp. motor with an attachment cord that fits common light sockets. This combination is also made with a capacity of 6000 ordinary dishes per hour for use in restaurants, hotels and hospitals. All gears and wearing parts of the dishwashers are inclosed and run in oil.

Electrically Operated Ticket Chopper

A ticket chopping machine, the knives of which are driven by a ¼-hp. electric motor, has been brought out by the Caille Brothers Company of Detroit, Mich. The motor is controlled by a push button, the pressing of which starts the mechanism and sends through the tickets, shredding them into small bits.

Electrically Driven Hand Sander

For removing stencil marks from shipping boxes and barrels, for surfacing floor treads, desk and table tops, and for other uses, the American Floor Surfacing Machine Company of 518 South St. Clair Street, Toledo, Ohio, has brought out its "American" electrically driven hand sander.

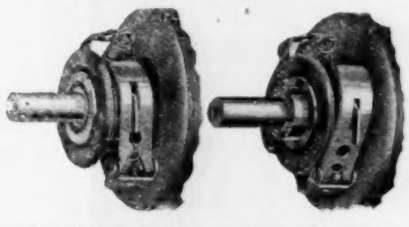
HARD KNOTS AND NAILS IN WOOD CAN BE CUT DOWN

A ⅓-hp. electric motor, on a light running truck, drives through a flexible shaft a sanding head 5½ in. (14 cm.) in diameter, made of metal and covered with felt, around which is placed a piece of garnet (sand) paper 3 in. (7.6 cm.) wide. A slot is provided across the sanding head through which the ends of the garnet paper are drawn and held in place by a quick-acting clamp.

Fifty feet (15 m.) of insulated wire for connecting the sander to an ordinary lighting circuit are furnished as well as a supply of garnet paper.

Starting Switch for Small Split-Phase Motors

The fractional-horsepower alternating-current motors which are put out by the Ellington Electric Company, Quincy, Ill., are equipped with a new type of centrif-



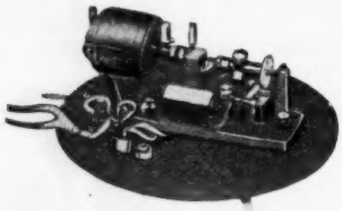
MECHANICAL JOINTS OF STARTING SWITCH CARRY NO CURRENT

ugal starting switch. The contact ring makes a half revolution on the stationary contacts when the motor is started and removes all dirt accumulated. Owing to lever arrangements of weights and springs the contacts open almost instantaneously. No current is carried by any mechanical joints so that they cannot stick because of

arcing or burning. On stopping, the ring contact makes only a half revolution, coming to rest long before the rotor, and minimizes wear between the stationary contacts and the ring contacts. The parts have been designed to be heavy and rugged and the action is positive. The design is said to afford large creeping distance of insulation, thereby preventing grounding by accumulation of dirt or wear.

Direct-Drive Phonograph Motor

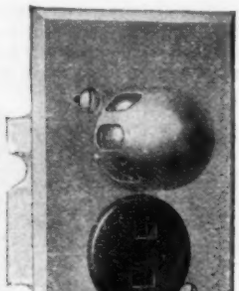
A direct-gear-drive electric motor for talking machines has recently been placed on the market by the Johnson Motor Company of Chicago. The gears are designed to run evenly and silently regardless of current fluctuations. In another type of motor made by this company the power is transmitted by an endless flexible belt. These motors operate on alternating current or direct current and may be connected to any 110-volt lamp socket.



GEAR-DRIVEN TALKING MACHINE

Receptacle and Warning Light for Switch Box

A standard flush receptacle and a warning light combined in a single porcelain which can be installed in a single-switch box has been added to the products of the Bryant Electric Company of Bridgeport, Conn. The receptacle used in the new combination is a regular "Spartan" receptacle and receives any standard parallel bladed caps. The 2-cp., 125-volt candelabra-base warning lamp is connected in parallel with the receptacle and is protected from mechanical injury by a perforated brass cage. This lamp can be renewed by simply removing the face plate of the device.

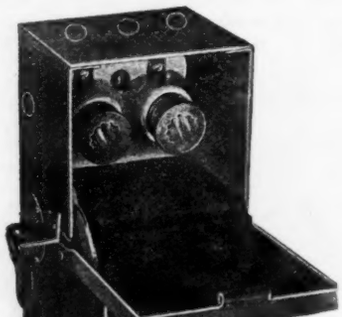


CAN BE INSTALLED IN A SINGLE-SWITCH BOX

Safety House-Entrance Switch

A safety, knife-type house-entrance switch, known as WK-53, has just been announced by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., which states that it can be operated without danger of shock; that the fuses can be renewed only when they are dead; that only authorized persons can reach live parts, and that the switch can be locked open if desired. It is supplied in a 30 amp., 125-volt size and especially adapted for house-entrance service.

The switch is mounted with two plug fuses on a porcelain base and is inclosed within a steel box. It is operated by a projecting handle and opens with a quick break. The cover of the box consists of two parts, hinged together. The upper part, which covers the knife switch, is held in place by screws, and the lower part forms a door, giving access to the fuses. It is, however, impossible to open this door unless the switch is in the off position when the fuses are dead. If the switch is closed when the door is open, the door closes also, and a barrier prevents access to the switch and terminals from the fuse compartment.



FUSES CAN BE RENEWED ONLY WHEN SWITCH IS DEAD

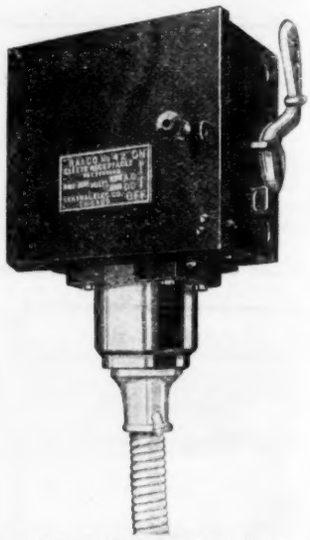
Safety Interlocked Receptacle and Plug

To afford the greatest degree of safety in controlling machines operating on three-phase circuits of over 250 volts the Central Electric Company, 316 South Wells Street, Chicago, is making a "Ralco" No. 42 safety interlocked receptacle plug, which is used in connection with a 60-amp. safety switch of the desired voltage.

Interlocking prevents the closing of the switch until the plug is pushed into the correct position, nor can the plug be withdrawn until the switch is pulled to the full "off" position. When the plug is withdrawn the switch automatically locks open. The door of the switch cannot be opened until the switch mechanism is in the full "off" position. Should any one, when testing, accidentally leave the switch closed, it is not possible, the maker declares, to insert the plug or bring it into contact with any live parts until the switch is opened.

The plug and receptacle have four contacts, one contact being grounded. The receptacle ground contact is permanently grounded through the box to the conduit in the usual manner. The plug ground contacts make control to the ground contacts of the receptacle before the live contacts of the receptacle are engaged.

The plug handle is threaded for 1¼-in. (3-cm.) Sprague hose armor, which is grounded through the plug-ground contacts. These receptacles and the plug are furnished for use on 250 volts direct current and 500 volts alternating current, not fusible, and for 600 volts alternating current or direct current, either fusible or non-fusible. The rating of the combination is governed by the switch.



LIVE PARTS CANNOT BE TOUCHED UNTIL PLUG IS OUT

Four-Slice Automatic Bread Toaster

An electric toaster that accommodates four slices of bread and automatically turns off the current when they are toasted has been placed on the market by the Strite Toaster Company, 422 Plymouth Building, Minneapolis, Minn., for use in hotels, cafés, tea rooms and soda fountains.

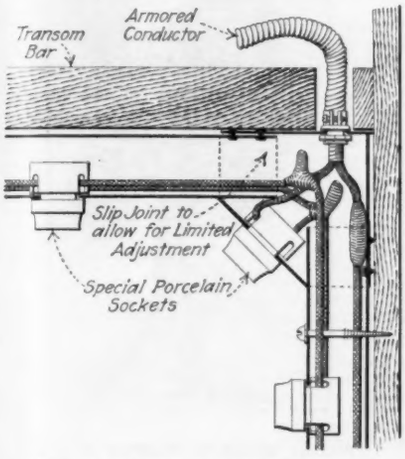
When the four slices of bread have been inserted a lever is pulled down, thereby lowering the bread into the toaster and turning on the current. As soon as the slices are toasted properly the lever is re-

SLICES AUTOMATICALLY LIFTED OUT OF TOASTER WHEN DONE

leased, the current is turned off and the toast is automatically lifted out of the machine, without attention from the user of the toaster. The toast is kept warm by the residual heat in the machine until it is taken out to be used.

Corner Panel for Show-Window Molding

To eliminate unsightly corners in show-window molding the Frederick A. Watkins Company of Chicago has evolved



SECTION OF CORNER PANEL FOR SHOW WINDOW MOLDING

a special panel which allows a lamp to be placed in the corner. Furthermore, the producer states, this affords more space than formerly for making wiring connections at the corners, which are usually congested points because here the feed wires enter the molding. This panel is of white porcelain-enameled steel to match the standard molding of this manufacturer.

Adjustable-Handle Suction Cleaner

For the convenience of people of different heights and for cleaning at different levels, as on flights of steps, the "Royal" electric cleaner made by the P. A. Geier Company of Cleveland, Ohio, has been equipped with a rack on which the handle may be set at any angle by means of a wing nut. When the machine is not in use the handle may be put in the upright position, where a spring catch holds it.

Electrically Operated Sausage Maker

For use by butchers in making fancy sausages, the Brecht Company, Twelfth and Cass Avenues, St. Louis, Mo., has placed upon the market a complete electrically driven sausage unit comprising a No. 042 "Enterprise" grinder, a No. 27 "Crescent" silent cutter and a 400-lb. (181-kg.) mixer, all run by a 5-hp. electric motor, transmitting its power through cut gears. Each of the three machines making up the combination is equipped with a clutch and can be run separately or with either or both of the others.

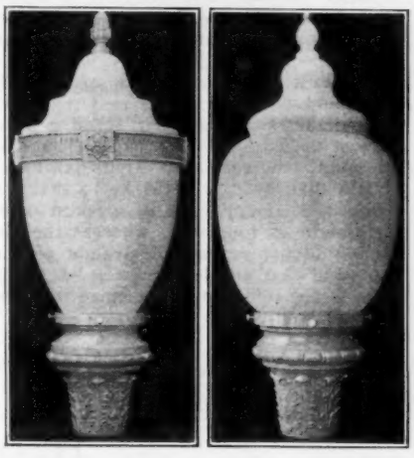
Ornamental Street-Lighting Units

Two new street-lighting units, known as "Novalux" forms 12 and 13, have been developed by the General Electric Company of Schenectady, N. Y.

In constructing the new form 12 unit the socket is mounted upon an insulating plate which rests upon lugs in the casing. In the case of the auto-transformer type the coil is fastened to the insulator. The casings have been designed for poles with top diameters of from 5 in. (12.7 cm.) to 9 in. (22.8 cm.).

The glass globe is stated to give as low absorption as is consistent with perfect diffusion. Its upper part is a separate glass canopy attached to the lower portion with an ornamental band of perforated sheet brass. The canopy is surmounted by a metal ornament. To prevent loss of light and to improve its appearance the bottom opening of the globes has been reduced to a minimum.

The form 13 unit is adapted for use in the secondary business districts of cities and to the lighting of towns and villages. Its lines are the same as those of form 12



TWO STYLES OF UNITS SHOWING SEPARATE CANOPIES

and the construction is said to be much the same.

Two types of casings may be used with the new units, differing not in appearance, but in method of attachment to the pole. The J casing rests upon the top of the pole and is bolted in place while the JK casing slips over the shaft and is fastened by set screws.

Oil-Break Switch

The non-automatic oil-immersed drum-contact switch marketed by the Textile Machine Works of Reading, Pa., for controlling motors of knitting machines is now rated at 550 volts instead of 230 volts.

Electro-Medical High-Frequency Outfit

An electro-medical high-frequency generator operating on alternating-current or direct-current circuits of 110 volts and giving three intensities of high-frequency current has been recently developed by the Bleadon-Dunn Company, 326 West Madison Street, Chicago, and is known as the "Multifrex." The new oufit weighs but 7 lb. (3 kg.) with cautery and diagnostic lamp attachments.

Locking Plug of Unit Construction

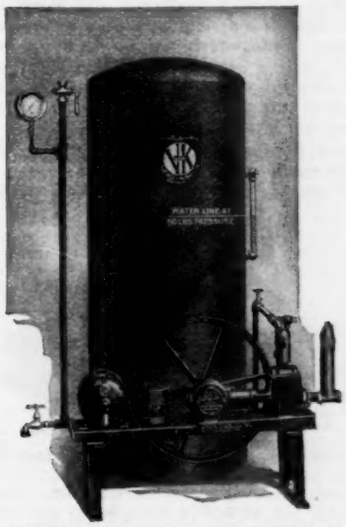
A quick make-and-break plug of unitary construction is being made by the Yost Electrical Manufacturing Company and distributed by the Peerless Light Company, Halsted, Adams and Green Streets, Chicago. It is called a "lockfast" plug and locks instantly by inserting and making a slight turn to the right. Disconnecting is accomplished by a reversal of this operation. The plug is designed to fit any Edison base socket or outlet.

QUICK MAKE AND BREAK PLUG

Automatic Electric Shallow Well Pump

For a small residence with but one bathroom and where there is only a small lawn, electric shallow-well-pumping system No. 192 has been developed by the Vaile-Kimes Company, 35 St. Clair Street, Dayton, Ohio. The pressure in the tank is automatically kept at between 35 lb. and 50 lb. by an automatic switch controlling the operation of the Westinghouse motor, which is moisture-proof and dust-proof.

The pump can be used only where the water level in the well is not more than 22 ft. (6.7 m.) from the pump. It is designed to draw water horizontally any reasonable distance within 200 ft. or 300 ft. (60 m. or 90 m.). The capacity of the pump is 210 gal. (794 l.) an hour.

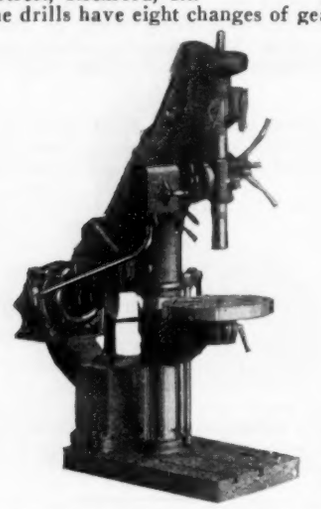


OPERATION OF PUMP IS AUTOMATIC

Self-Oiling All-Geared Drills and Tappers

Single-spindle, self-oiling, all-geared 24-in. (60-cm.) drills and tappers driven by 5-hp. General Electric motors and equipped with GE type CR-1038 starters have recently been placed on the market by the Barnes Drill Company, 814 Chestnut Street, Rockford, Ill.

The drills have eight changes of geared



EQUIPPED WITH SELF-CONTAINED GEARED OIL PUMPS

speed and eight changes of geared feed, all under instant control from the front of the machines.

High-speed twist drills in sizes from ½ in. (12.7 mm.) to 1¾ in. (44.5 mm.) are handled at suitable speeds and feeds.

Vibration-Proof Shade Holders

To prevent a reflector from becoming loose and finally dropping from the shade holder because of vibration the National X-Ray Reflector Company, 235 West Jackson Boulevard, Chicago, has developed a shade holder designed to firmly grip the neck of the reflector with equal pressure all around without the use of set screws against the reflector. Instead a screw is used to lessen the circumference of the shade holder, thereby making it grip the reflector.

These new shade holders are made in

SHADE HOLDER PROOF AGAINST VIBRATION

three styles. The form A 3¼-in. (8-cm.) holder No. 10,400 is made to fit any brass-shell socket; the form A 3¼-in. (8-cm.) holder No. 10,500 fits any porcelain or weatherproof socket, and the form A 3¼-in. (8-cm.) holder No. 10,300 fits either No. 8053 or No. 8223 standard X-ray receptacle.

Battery-Charging Voltage Regulator

For operation on alternating current the U. S. E. M. Company, 301 West Thirty-seventh Street, New York City, has recently developed its rectifier type ACR automatic battery-charging voltage regulator. This device, which is known as a potentiostat, the maker states, can be used for bell ringing and in other cases where low voltage is required with alternating-current operation.

The device has an ammeter and voltmeter reading both charge and discharge and a trouble lamp for indicating low voltage of the cells. All working parts are inclosed in a dust-proof brass case having a glass front.

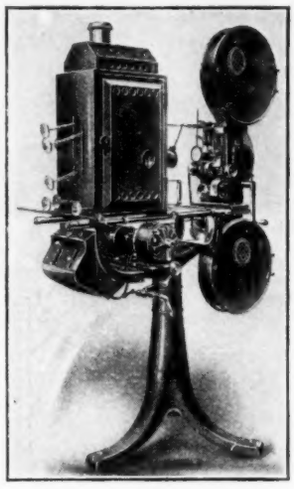
Strong Jar for Storage Batteries

As a result of its efforts to develop an unbreakable jar for storage batteries the Electric Storage Battery Company, Allegheny Avenue and Nineteenth Street, Philadelphia, has brought out the "Giant" jar for its "Ironclad-Exide" storage battery.

The new jar is made of a semi-flexible compound. Tests are stated to have proved that these jars will stand a pressure of 2000 lb. (907 kg.) at their weakest point, whereas the old-type jar broke at less than 1000 lb. (453 kg.); that the new jar will support at its weakest point the weight of four men, whereas the old jar would not support the weight of one man, and that an electrical test of 30,000 volts is not sufficient to puncture the new jar.

Motion-Picture Projector with Few Gears

An important feature of the "Master" motion-picture projector which has just been developed by the Master Machine Tool Company, 2638 Park Avenue, New York City, is its motor drive and the method of speed control, which is mechanical and consequently uses no rheostat.



PULLEY REPLACES FRICTION CLUTCH AND RHEOSTAT

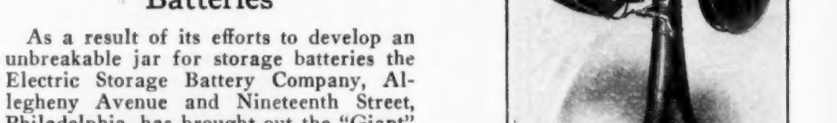
The lamphouse of the machine is said to be large and well ventilated. Six handles control the movements of the lamp so that a suitable arc may be secured. The carbon jaws are made extra heavy to insure good contact and to prevent burning out.

Electric Sheet Heater for Removing Static from Printing Paper

An electric sheet heater which is said to remove static electricity from the printed paper and to heat the air under the sheet, thus giving it buoyancy, which prevents it resting heavily on the sheet beneath and so smearing, is about to be placed on the market by Britton & Doyle, 205 Caxton Building, Cleveland, Ohio. In addition the heater may be adjusted to dry the ink on the sheets as much or as little as circumstances require.

The new heater is an open-glow type which is fastened to the printing press so that an intense live heat is concentrated on the sheets as they pass through. The heater may be attached to any or many parts of the press right at the seat of trouble. It is divided up into 6-in. (15-cm.) sections, which may be used singly, severally or in any combination needed, depending on the size of the sheets. The makers declare that repairs can easily be made on the heater if necessary, though the heating wire is designed to withstand severe strain.

Among the advantages of the electric sheet heater over one using gas, it is pointed out that there is no danger of the electric heater igniting the sheets of paper; it cannot "go out," allowing the gas to escape and necessitating a stoppage of the press for relighting, nor does it give off fumes injurious to the health of the pressmen.



ELIMINATES STATIC ELECTRICITY IN PRINTED SHEETS OF PAPER

Manufacturers' Activities

FRANK O'RYAN has been appointed district manager of the Allis-Chalmers Manufacturing Company, Denver, Col.

THE HOOKER ELECTROCHEMICAL COMPANY, 40 Wall Street, has purchased the ten-story building at 25 Pine Street, New York City, with the expectation of using several floors of it for its executive offices.

THE EDISON STORAGE BATTERY COMPANY, Orange, N. J., has just started a quarterly publication called "The Grid" to "disseminate some sense and a little nonsense among users of storage batteries."

O. P. WILSON, who has been assistant general manager for several years, was recently elected vice-president of the Norma Company of America, ball-bearing manufacturers, 1790 Broadway, New York, at a meeting of the board of directors.

THE FEDERAL TRADE COMMISSION in September issued formal complaints alleging unfair trade practices against the Electric Appliance Company, Burlington, Kan., for false and misleading advertising, passing off of name and misrepresentation.

THE COOPER HEWITT ELECTRIC COMPANY'S convention of salesmen took place Oct. 27-28 at the main office of the plant at Hoboken, N. J. About thirty salesmen attended the convention, which closed with a dinner at the Hotel Pennsylvania.

THE BATTRYGUARD MANUFACTURING COMPANY, 123 East Sixth Street, Los Angeles, Cal., which has recently been incorporated, is establishing a factory and intends to sell a patented device to lengthen the life of a storage battery used on automobiles.

THE BARLOW ELECTRICAL SPECIALTIES COMPANY, Yonkers, N. Y., announces that it has just perfected a new model of arc regulator, motor-driven and of entirely new design. The new apparatus will not be ready for the market, however, until about the first of next year.

INDUSTRIAL LIGHTING CAMPAIGN.—A prospectus offering suggestions for operating by mail a special industrial lighting campaign is being placed this fall by the National Lamp Works at the disposal of its larger distributers. Special emphasis is placed on making an installation having the proper quality and quantity of lights. It is expected that the campaign will result in a material increase in the sale of lamps and other lighting equipment.

THE COOPER STORAGE BATTERY MANUFACTURING COMPANY, Madisonville, Ohio, which was recently incorporated, will have a capacity of 100 batteries per day. This is a new company in the field of starting and lighting batteries for automobiles. The general offices are at the factory, and the product will be distributed through jobbers. I. J. Cooper is president, H. H. Brenner vice-president, Leon Percy secretary and treasurer, and C. W. Noll is sales manager.

THE DAYTON ENGINEERING LABORATORIES COMPANY, Dayton, Ohio, manufacturers of Delco starting, lighting and ignition equipment for automobiles, reports that, although its weekly production of Delco systems since the resumption of peace-time work has been steadily increasing, its production for the week Oct. 18 reached a record of 7200 systems. In addition to the expansion of gross production, many parts are being made in the Delco plant that were previously purchased outside of Dayton and built into the apparatus in that plant. The armature plant is showing a steady, healthy expansion. All parts of the ignition distributor mechanism are now being manufactured in the Dayton plant.

THE LINK-BELT COMPANY, Indianapolis, Ind., will build a one-story addition to its foundry. The new addition will be brick and steel, 70 ft. by 460 ft., to cost $65,000.

THE IMPORT SALES COMPANY, 27 to 33 West Twentieth Street, New York City, on Oct. 20 changed its name to the Diamond Electrical Specialties Corporation. The company will continue to manufacture its line of diamond flashlights and batteries, Christmas tree outfits and other specialties under its new name.

M. L. SPAULDING

M. L. SPAULDING has been appointed manager of the Chicago office of the Trumbull Manufacturing Company. Mr. Spaulding left the sales force of this office two years ago to become general sales manager of the Varney Electric Supply Company, Indianapolis, Ind. He was formerly connected with the Julius Andrae & Sons Company, Milwaukee, Wis., and with the Bryan-Marsh division of the National Lamp Works, Chicago, Ill.

WESTINGHOUSE CHANGES.—H. U. Hart, chief engineer of the Canadian Westinghouse Company, Ltd., has been appointed general manager, succeeding Mr. Merrick, resigned. Mr. Merrick, however, remains vice-president and a member of the board of directors of the company. C. H. Mitchell, formerly assistant superintendent of electrical department, has been appointed assistant manager of the Canadian company's works. R. E. Cullings has been appointed general foreman in charge of the electrical department at the Essington works. H. C. Thomas has been appointed assistant to the manager of the St. Louis office.

THE AMERICAN MALLEABLE CASTINGS ASSOCIATION, Cleveland, Ohio, reports, in connection with the insistent demand for malleable castings, that this condition has been anticipated and that ample facilities have been provided for both the present and future expansion of the industry. It is stated, however, that at the present time the shortage of unskilled labor will not permit this great capacity being used. Fully 200,000 tons of malleable capacity is now idle. Improvement in this direction is not looked forward to with any great hope until the activities of other industries are curtailed or until there is a flow of immigration sufficient to build up the supply of labor available for foundry work.

THE INGERSOLL-RAND COMPANY, 11 Broadway, New York City, has established a branch office in the Sam Houston Life Building, Dallas, Tex., in order to serve better the rapidly developing industries in that territory. R. H. Brown, Jr., has been placed in charge as manager, after having been connected with the St. Louis office for several years.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, has appointed W. H. Thompson as works manager. Mr. Thompson was recently works manager of the Fairmont Mining Machinery Company, Fairmont, W. Va., and previously had spent twelve years with the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

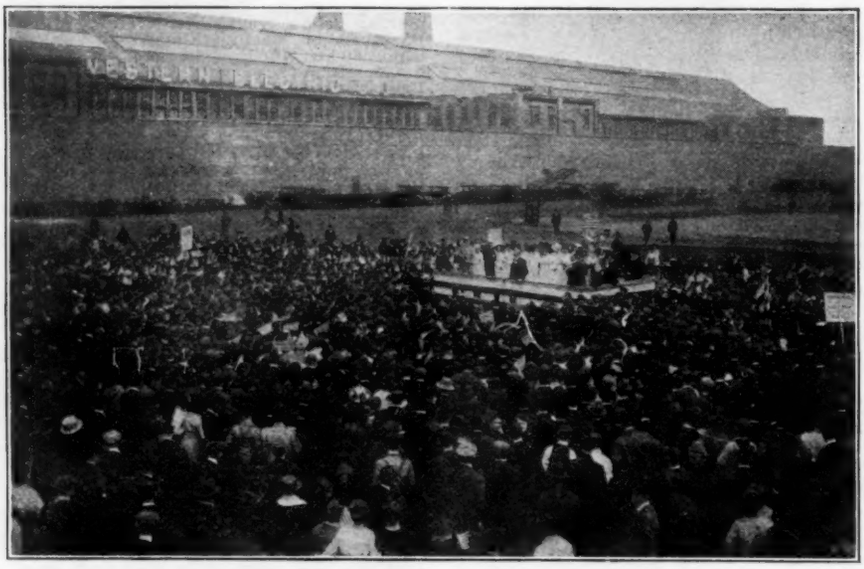
THE ELECTRIC FURNACE COMPANY, Alliance, Ohio, has just installed nine new Bailey electric furnaces for melting a wide range of non-ferrous metal and alloys, as follows: Drew Electric & Manufacturing Company, Cleveland, Ohio, 105-kw. furnace for melting yellow brass; Nolte Brass Company, Springfield, Ohio, 105-kw.-furnace, of 1500 lb. capacity for melting yellow brass; Kennedy Valve Company, Elmira, N. Y., 105-kw. furnace for melting red brass; American Bronze Corporation, New York City, two 1500-lb. furnaces for melting bronze; Dominion Steel Products Company, Brantford, Ontario, Canada, 50-kw. furnace of 500 lb. capacity for melting yellow brass; Deming Company, Salem, Ohio, 500-lb. furnace for melting yellow brass and red brass; Miller Pasteurizing Machine Company, Canton, Ohio, 50-kw. furnace for melting yellow brass; Landers, Frary & Clark, New Britain, Conn., 50-kw. furnace for melting aluminum.

UTILITY MEN ENTER ELECTRIC FURNACE BUSINESS.—During the last part of September there was organized in Chicago a new corporation under the laws of the State of Illinois to be known as the Booth Elcetric Furnace Company, with paid-up capital of $1,000,000. The new company has acquired all the patents, assets and good will of the Booth-Hall Company, manufacturer of electric steel and brass melting furnaces, and has taken over the business formerly carried on by that company. It will enlarge the scope of operations and develop the electric furnace business for both ferrous and non-ferrous metals, along standard manufacturing lines rather than on a special engineering contracting basis. The Booth rotating furnace, which has been in operation during the last six months, and which is especially designed for the melting of non-ferrous metals, has been developed and standardized, and the company is prepared to deliver this type of furnace in four sizes, viz., 250-lb., 500-lb., 1000-lb. and 2000-lb. equipments. The two-phase, two-electrode Booth-Hall furnace for the melting of iron and steel will also be made in five sizes,—¾-ton, 1½-ton, 3-ton, 6-ton and 12-ton. An improved type of furnace, oval in shape, has been designed, and prompt shipment can be made of any one of these five sizes. The new company will have manufacturing facilities for turning out furnaces in quantities. Not only have all parts been standardized, but each furnace will be assembled complete before shipment and thoroughly tested out to insure mechanical and operating perfection. Associated in the management of the company will be L. E. Myers of Chicago, president of the L. E. Myers Company, president; C. H. Booth, formerly president of the Booth-Hall Company, vice-president; W. K. Booth, formerly chief engineer of Booth-Hall Company, secretary, and L. J. Clark, of the L. E. Myers Company, treasurer. In addition to the president, vice-president and secretary, the board of directors will include Martin J. Insull, vicepresident of the Middle West Utilities Company, and E. W. Lloyd, general contract agent of the Commonwealth Edison Company, both of Chicago. The new company is prepared to carry on an aggressive campaign for business and will open sales offices in different parts of the country. An adequate engineering staff will be maintained to co-operate with customers in connection with electrometallurgical problems, especially those relating to the melting of metals.

Supply Jobbers' Notes

THE INDEPENDENT ELECTRICAL SUPPLY COMPANY, New York City, announces that, in line with its policy of having its employees share in the profits of the company, Charles Walker has received as of Sept. 2 a substantial interest in the firm and been elected first vice-president.

THE ST. PAUL ELECTRIC COMPANY, St. Paul, Minn., announces its appointment by the Westinghouse Electric & Manufacturing Company as agent-distributer for the Northwest territory. The company will carry a complete and varied stock of Westinghouse products including motors, meters, transformers and other power apparatus. It is setting aside an entire floor in its building for this purpose. Facilities have been arranged for handling engineering work in connection with the proper installation of this apparatus. M. R. White is managing this particular department. This Westinghouse agency will, in addition to the other manufacturers that the company represents in the Northwest, enable the St. Paul Electric to supply almost anything from a socket bushing to a steam-driven turbo-generator.



PART OF WESTERN ELECTRIC'S 30,000 EMPLOYEES AT HAWTHORNE

WESTERN ELECTRIC COMPANY'S FIFTIETH ANNIVERSARY.—Fifty years ago this month the firm of Gray & Barton was formed with a capital of $5,000 to manufacture telegraph instruments, bells and buzzers and for doing a general electrical business. Out of this firm grew the Western Electric Manufacturing Company in 1872, which in turn was reorganized in 1881 as the Western Electric Company. The present company has developed until now its activities cover the entire world. After 1881 the company's chief business became the design and manufacture of telephone equipment for the American Bell Telephone Company, with which company the Western Electric Company in 1882 entered into contract. In the foreign field the company's business has steadily grown until now its allied and associated companies operate factories or sales offices in virtually every civilized country. In the merchandise used by its telephone customers the company was able to do a constructive job of standardization and inspection, and built up a considerable business among the Bell companies in their requirements of line material and other miscellaneous merchandise. From this grew the task of coordinating the purchasing and stock-keeping functions of the various countries, until, through the supply contracts entered into with the Bell company, distributing houses, in which were carried the stocks formerly owned by the local telephone companies, were opened in many cities to the present number of forty-five warehouses. From the founding of the company in 1869 there were manufactured miscellaneous electrical products. By reason of the reputation which the company had made early as headquarters for electrical apparatus, buyers came into the field for electrical material which the Western Electric Company did not manufacture. To meet this latter demand, the company bought such goods of the makers and resold them to the user, and in this manner started on a jobbing career from which it has emerged as the largest electrical jobbing organization probably in the world, operating from forty-two distributing points. In the days when the Chicago headquarters were at Clinton Street the company manufactured fans, arc lamps, motors, generators and power and lighting switchboard equipment. The Hawthorne plant was built in 1903 principally to manufacture power apparatus, but after the year 1909 the company ceased manufacturing fans, lighting equipment and power apparatus, turned over its plant to meet the fast increasing needs of the telephone manufacturing end of the business and made arrangements with other suppliers for the handling of their lighting and power equipment. Although the jobbing business dated back to 1869, up to 1900 it was operated from the New York and Chicago offices only. In 1901 the first distributing house was established in Philadelphia, and other houses followed.

Foreign Trade Notes

CHAMPION & RYAN, INC., 299 Broadway, New York City, announce that C. H. Champion, who has been traveling through England, France and Italy on behalf of this company, is returning to America early in October with specifications and particulars of electrical supplies and specialties required for these markets.

P. RAVET, electrical engineer, 51 Rue du Sahel, Paris, France, desires to be put in touch with American manufacturers who wish a representative for their goods in France. He is particularly interested in patented novelties, high-tension porcelain and apparatus made in the United States filling an industrial need which cannot be met by French manufacturers. Technical, commercial and financial references can be supplied.

Trade Publications

CURRENT TAP.—Harvey Hubbell, Inc., of Bridgeport, Conn., has issued Bulletin No. 16-15, covering No. 6700 current tap.

CURRENT TAP.—Circular No. 191 has been issued by Harvey Hubbell, Inc., of Bridgeport, Conn., to describe its No. 6700 current tap.

HOME MOTOR. — The Hamilton-Beach Manufacturing Company of Racine, Wis., has issued an illustrated leaflet telling about its electric home motor.

STORAGE BATTERIES.—The Electric Storage Battery Company, Allegheny Avenue, Philadelphia, has issued a booklet entitled "Know Your Battery Better."

BELL-RINGING TRANSFORMERS.—The Standard Transformer Company of Warren, Ohio, is circulating an illustrated folder about its bell-ringing transformers.

HEATERS.—The universal radiant electric heater, recently developed by Landers, Frary & Clark of New Britain, Conn., is described and illustrated in its folder No. 660.

WATER SUPPLY SYSTEM.—The Dayton Pump & Manufacturing Company, Dayton, Ohio, has prepared an illustrated booklet which tells about its automatic water supply system.

COMBINATION DRILL AND VALVE GRINDER.—The Fairbanks Company of New York City has issued an illustrated booklet about the Bilt-Rite combination electric drill and valve grinder.

AIR-COMPRESSING SYSTEM.—The B. E. Holton Company, 1009 South Figueroa Street, Los Angeles, Cal., has issued a leaflet about its Behco air-compressing system for use with air brushes.

COOKING EQUIPMENT.—The Duparquet, Huot & Moneuse Company, 108 West Twenty-second Street, New York City, is circulating an illustrated folder on its electric equipment for hotels and clubs.

RENEWABLE FUSE.—A price list on the National renewable fuse has been issued by the Federal Electric Company, representing the Federal Sign System (Electric), Lake and Desplaines Streets, Chicago.

ATTACHMENT PLUG AND CORD CONNECTOR.—Bulletin No. 16-16 from Harvey Hubbell, Inc., of Bridgeport Conn., covers a composition attachment plug and cord connector for small motors, a heavy-duty polarized attachment plug and a composition elongated cap.

New Incorporations

THE SULPHUR (Tex.) ICE, LIGHT & POWER COMPANY has been incorporated with a capital stock of $30,000 by Paul G. Katie and Walter Liebman.

THE MOUNT JEWETT (Pa.) ELECTRIC COMPANY has been incorporated with a capital stock of $25,000 by W. H. Brown of Ridgway, F. S. Lower of Kane and H. C. Westphal of Johnsonburg.

THE SAUK COUNTY UTILITIES COMPANY of Baraboo, Wis., has been incorporated by W. A. Toole, E. C. Kunzelman and Fred J. Paddock. The company is capitalized at $12,000 and proposes to generate and distribute electricity for lamps, heaters and motors.

THE PENNS CREEK HYDROELECTRIC COMPANY of New Berlin, Pa., has been chartered for the purpose of supplying electricity for lamps and motors in the borough of New Berlin. The incorporators are F. Q. Hartman, Miles A. Zeigler and A. Pritchard.

Record of Electrical Patents

Notes on United States Patents

Issued September 30, 1919)

1,317,216. METHOD FOR ESTABLISHING OSCILLATIONS AND MECHANISM THEREFOR; John F. Perkins, Milton, Mass. App. filed April 9, 1915. Any desired vibration rate secured.

1,317,254. CONTROL SYSTEM; Thomas C. Wurts, Pittsburgh, Pa. App. filed Sept. 21, 1916. For motor vehicle with one or more motors.

1,317,256. PERCOLATING APPARATUS; Theodore Abtmeyer, Wilkinsburg, Pa. App. filed April 14, 1913. Uses fountain tubes attached to heater members.

1,317,266. SYSTEM OF CONTROL; Andrew H. Candee, Pittsburgh, Pa. App. filed Oct. 3, 1917. For acceleration and electrical braking.

1,317,268. SIGNAL; George A. Cole, New York, N. Y. App. filed Aug. 16, 1917. For railway crossings, drawbridges, and trains.

1,317,270. AUTOMATIC TELEAPPARATUS TO LIMIT AND REGULATE THE SPEED OF REVERSIBLE ENGINES; Leon J. Creplet, Paris, France. App. filed Oct. 30, 1916. Motor speed inversely as dynamo speed.

1,317,277. ELECTROTHERAPEUTIC APPARATUS; James H. Eastman, Detroit, Mich. App. filed April 23, 1919. Special electrode used.

1,317,278. ELECTROTHERAPEUTIC APPARATUS; James H. Eastman, Detroit, Mich. App. filed May 5, 1919. High-frequency generator.

1,317,280. TRANSFORMER; Alfred G. Ellis, Bowdon, Eng. App. filed Nov. 7, 1917. Core type with high internal reactance.

1,317,283. CONTROL SYSTEM; Ralph E. Ferris, Swissvale, Pa. App. filed Oct. 14, 1916. Regenerative systems with a third-rail conductor.

1,317,284. CONTROL SYSTEM; Ralph E. Ferris, Swissvale, Pa. App. filed Oct. 14, 1916. Regenerative control for motor vehicles.

1,317,287. CONTROL SYSTEM; Arthur J. Hall, Wilkinsburg, Pa. App. filed July 19, 1917. Eliminates current surges.

1,317,292. CONTROL SYSTEM; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed Nov. 25, 1914. Prevents flashovers by automatically increasing field current.

1,317,328. POLYPHASE ELECTRIC FURNACE; Mark Shoeld, Chicago, Ill. App. filed Nov. 20, 1918. Proper distribution of current flows.

1,317,335. DYNAMO FRAME; Carl M. Tichenor, Allston, Mass. App. filed Aug. 11, 1915. Field structure and armature housing.

1,317,338. WARNING SIGNAL FOR GRADE INTERSECTIONS AND HIGHWAYS; Per Utne, Edgewood Borough, Pa. App. filed Dec. 15, 1915. Pendulum type.

1,317,381. REFILLABLE ELECTRIC FUSE; William F. Muller, Brooklyn, N. Y. App. filed Dec. 18, 1918. Plug type.

1,317,382. MULTIPLE - SWITCH - LOCKING MECHANISM; William J. Newton, Bridgeport, Conn. App. filed Nov. 18, 1918. For magneto, starting and lighting switches.

1,317,400. MODULATING SYSTEM; Hugh M. Stoller, New York, N. Y. App. filed Dec. 21, 1916. Avoids capacity effects.

1,317,435. SYSTEM OF WIRELESS TELEGRAPHY AND TELEPHONY; Pieter de Lange, Utrecht, Netherlands. App. filed March 23, 1915. Material conductor and receiver in the form of detector.

(Issued October 7, 1919.)

14730 (reissue). OVEN FOR BURNING OUT INVERTED MODELS; Theodore W. Maves, Minneapolis, Minn. App. filed Sept. 24, 1918. For dental castings.

14,733 (reissue). ELECTRIC METER; John L. Axen, Detroit, Mich. App. filed Nov. 27, 1917. For calibrating instrument.

1,317,705. METHOD OF FIXATION OF ATMOSPHERIC NITROGEN; James S. Island, Hamilton, Ontario, Canada. App. filed Oct. 25, 1917. Lower costs for oxides of nitrogen.

1,317,757. CENTRIFUGAL SWITCH; Abe L. Cushman, Concord, N. H. App. filed Jan. 14, 1915. Controls starting winding of single-phase induction motor.

1,317,767. TRANSFORMER; Chester H. Thordarson, Chicago, Ill. App. filed Sept. 27, 1915. Protects low-tension winding against excessive loads.

1,317,772. ELECTRIC CURRENT CONTROLLER; Harry L. Bradley, Milwaukee, Wis. App. filed May 3, 1916. Maximum pressure variations obtained.

1,317,773. MOTOR STARTER OR ELECTRIC CURRENT CONTROLLER; Harry L. Bradley, Milwaukee, Wis. App. filed June 5, 1916. Less weight and space required.

1,317,774. ELECTRIC CURRENT CONTROLLER; Lynde Bradley, Milwaukee, Wis. App. filed July 29, 1916. Carbonaceous material with high-contact resistance.

1,317,786. MAGNET; Stewart H. Hartshorn, Short Hills, N. J. App. filed Oct. 26, 1916. Increases speed of magnetization and demagnetization.

1,317,798. BRAKE; David C. Larson, Yonkers, N. Y. App. filed Oct. 15, 1917. Controls brake applying and releasing mechanism in elevator system.

1,317,821. ELECTRIC SWITCH; Clarence D. Platt, Bridgeport, Conn. App. filed May 1, 1919. High current-carrying capacity.

1,317,838. ELECTRIC FUSE; Luigi Vecchio, Albany, N. Y. App. filed March 31, 1917. Renewable cartridge type.

1,317,859. TELEGRAPHY; William M. Bruce, Jr., Springfield, Ohio. App. filed March 4, 1915. Insures even distribution.

1,317,863. ELECTRIC FURNACE; Paul de Miles, New York, N. Y. App. filed Jan. 25, 1918. Crucible type.

1,317,864. ELECTRIC FURNACE; Paul de Miles, New York, N. Y. App. filed Jan. 25, 1918. Oven type heated by electrical resistance material.

1,317,877. CONNECTION FOR SECURING STABILITY FOR THE PARALLEL OPERATION OF TWO DIRECT-CURRENT MACHINES; Hendrik A. W. Klinkhamer, Delft, Netherlands. App. filed Oct. 16, 1917. Each commutatingfield winding excited by armature current of another machine.

1,317,883. METHOD OF GENERATING RADIANT ENERGY AND PROJECTING SAME THROUGH FREE AIR FOR PRODUCING HEAT; William M. Meacham, Seattle, Wash. App. filed April 12, 1915. Heating by impact of radiant energy waves.

1,317,906. CIRCUIT CLOSER FOR VEHICLE SIGNALS; Joseph J. Benedict, Cleveland, Ohio. App. filed June 14, 1918. Automatic in closing and breaking circuit.

1,317,911. ELECTRODE FURNACE; Waldemar Dyrssen, New York, N. Y. App. filed Dec. 21, 1918. Supports or counterbalances electrodes.

1,317,984. AMALGAMATOR; James A. Malone, Grayson, Ky. App. filed Aug. 22, 1917. Agitation and use of mercury.

1,317,991. DICTOGRAPH; Louis Scher, New York, N. Y. App. filed Feb. 26, 1918. Transmitter of telephone.

1,317,992. MAGNETIC SEPARATOR; John G. Sekinger, Ford City, Pa. App. filed July 21, 1915. For manufacture of glass.

1,318,044. AUTOMATIC TELEPHONE SYSTEM; Bernard D. Willis, Chicago, Ill. App. filed Sept. 19, 1917. For mixed-service system.

1,318,028. ZIGZAG CARBON ELECTRIC RESISTOR; John Thomson, New York, N. Y. App. filed Oct. 7, 1918. Alternating slots maintained at a high or low temperature.

1,318,029. ZIGZAG CARBON ELECTRIC RESISTOR; John Thomson, New York, N. Y. App. filed Oct. 7, 1918. Prevents the oxidization of the resistor.

1,318,030. TUBULAR ZIGZAG CARBON ELECTRIC RESISTOR; John Thomson, New York, N. Y. App. filed Oct. 7, 1918. Resistor members connected in series.

1,318,031. TUBULAR ZIGZAG CARBON ELECTRIC RESISTOR; John Thomson, New York, N. Y. App. filed Oct. 7, 1918. Adapted to heat articles placed in the interior.

1,318,053. METHOD OF ELECTROPLATING; Michael F. Davoran, Cincinnati, Ohio. App. filed Aug. 3, 1917. Controls thickness of electroplating.

1,318,054. APPARATUS FOR ELECTROPLATING; Michael F. Davoran, Cincinnati, Ohio. App. filed Aug. 3, 1917. Provides a plating tank with cathode bars at different elevations.

1,318,099. POWER-OPERATED SWITCH; Niels L. Mortensen, Milwaukee, Wis. App. filed Sept. 5, 1916. Torque motor-operating mechanism for oil switches.

1,318,126. POWER-FACTOR METER; Donald J. Angus, Indianapolis, Ind. App. filed Feb. 28, 1919. Requires no relative adjustment.

1,318,128. ELECTRICAL RESISTANCE; Hiram P. Barnes, Laporte, Ind. App. filed June 9, 1917. Dimming automobile headlights.

1,318,131. DOUBLE-THROW ELECTRIC SWITCH; George A. Burnham, Saugus, Mass. App. filed May 28, 1917. For use in manholes.

1,318,147. APPARATUS FOR INCREASING THE RESISTANCE OF ELECTRIC ARCS; Albert B. Herrick, Brooklyn, N. Y. App. filed March 30, 1917. For welding a bond to a rail joint.

1,318,152. BEVERAGE-MIXING DEVICE; William A. Hughes and James P. Pantages, Chicago, Ill. App. filed Nov. 10, 1917. Prepares hot and cold beverages.

1,318,164. PROCESS OF MANUFACTURING ELECTRIC STEEL; John McConnell, Chicago, Ill. App. filed Jan. 8, 1918. Refining molten products.

1,318,165. WIRELESS ELEVATOR-SIGNALING SYSTEM; Frederick S. McCullough, Cleveland, Ohio. App. filed Jan. 22, 1917. Avoids connecting the elevator with the floors by wires.

1,318,168. AUTOMATICALLY CONTROLLED ELECTRIC COFFEE COOKER; John F. Newsom, Palo Alto, Cal. App. filed May 29, 1916. Thermostatic switch control.

1,318,178. CIRCUIT CONTROLLER; Walter C. Reed, Dalton, Mass. App. filed Oct. 25, 1916. Sensitive and rapid in action.

1,318,196. ELECTRICAL DEVICE; Theodore W. Case, Scipio, N. Y. App. filed Jan. 22, 1918. For controlling or balancing aëroplanes, boats and ships.

1,318,208. COMMUTATOR; Hilles C. Jones, Allentown, N. J. App. filed Feb. 3, 1919. Protects wires leading from commutator.

1,318,237. ARRANGEMENT FOR THE HEATING OF ROOMS BY MEANS OF ELECTRIC THERMOGEN; Innocente Sordi, Milan, Italy. App. filed Aug. 28, 1918. Electric heater applied to radiator system.

1,318,243. ELECTROPNEUMATIC BRAKE; Walter V. Turner, Wilkinsburg, Pa. App. filed April 2, 1917. Application and release magnets separately controlled through a common transmission line.

1,318,244. PROTECTOR FOR CONTACT FINGERS; Walter V. Turner, Wilkinsburg, Pa. App. filed Sept. 10, 1917. Provides means for protecting contact fingers.

1,318,277. DETECTOR FOR WIRELESS TELEGRAPHY AND TELEPHONY; Fred S. Hover, Hyde Park, N. Y. App. filed Dec. 14, 1917. Detector members free from dust and atmospheric conditions.

1,318,342. RADIO-SELECTIVE SYSTEM; John Hays Hammond, Jr., Gloucester, Mass. App. filed Feb. 5, 1913. Selective reception of electric wave signals and impulses.

(Issued Oct. 14, 1919)

1,318,345. MOTOR-STARTING DEVICE; Carl J. Anderson, Chicago, Ill. App. filed June 21, 1916. Solenoid-operated.

1,318,364. ELECTRIC BATTERY; Jay E. Dunn, Brooklyn, N. Y. App. filed Sept. 23, 1916. Light in weight and leak-proof.

1,318,369. INDICATOR; Joseph C. Fischer, Wauwatosa, Wis. App. filed Aug. 16, 1917. Shows broken circuit, battery failure or hot journal box.

1,318,431. METHOD OF SEPARATING THE OXIDES OF IRON AND OTHER METALS OCCURRING IN COMPOUND ORES; James C. Adell, Cleveland, Ohio. App. filed Dec. 2, 1916. Pyrolusite recovered from mixed ores of pyrolusite and hematite by magnetic separation.

1,318,432. PROCESS OF PREPARING HIGHLY OXIDIZED MANGANESE COMPOUNDS; James C. Adell, Cleveland, Ohio. App. filed Aug. 20, 1917. Manganese dioxide precipitated by electrolysis.

1,318,453. ADJUSTABLE FAN FOR DYNAMO-ELECTRIC MACHINES; Austin Kimble, Wausau, Wis. App. filed May 18, 1918. Automatically governed vanes responsive to motor speed.

1,318,459. TELEGRAPH SYSTEM; Harry Pfannenstiehl, East Orange, N. J. App. filed July 24, 1917. Controls receipt and transmission of messages.

1,318,478. CIRCUIT CLOSER FOR ELECTRIC SIGNALING DEVICES; William K. Buckles, Rifle, Col. App. filed June 26, 1918. Operated by push-button on steering wheel.

1,318,495. APPARATUS FOR ELECTRICALLY WELDING BOILER TUBES TO FLUE SHEETS THEREOF; Frederick T. Huston, Fort Wayne, Ind. App. filed Feb. 14, 1916. Metal expanded after being heated.

1,318,508. ELECTRIC SWITCH; Arthur Simon, Milwaukee, Wis. App. filed April 19, 1911. Horizontal oil break.

1,318,554. ELECTRIC HEATER; August Harth, Chatham, N. J. App. filed Aug. 28, 1914. Plug and socket for series or parallel connections.

1,318,563. ELECTRIC WELDING APPARATUS; William H. Isherwood, Far Headingley, Leeds, Eng. App. filed March 13, 1918. Operated by hand or foot.

1,318,620. MOTOR CONTROLLER; William C. Stevens, Summit, N. J. App. filed Nov. 30, 1914. Uniform deceleration irrespective of load.

1,318,653. MULTIPLE-FUSE PLUG; Frederick A. Feldkamp, Newark, N. J. App. filed March 31, 1919. Eliminates expensive male-thread shell.

1,318,655. FUSE BOX; Harry F. Fisher, Columbus, Ohio. App. filed July 26, 1917. Pull rod attachment.

1,318,670. SELECTIVE SIGNALING APPARATUS; Horace Hull, Denver, Col. App. filed June 25, 1914. Alternating-current system with stations in multiple.

1,318,696. APPARATUS FOR STARTING SYNCHRONOUS MACHINES; Emanuel Rosenberg, Bowdon, Eng. App. filed March 24, 1915. Synchronous-booster converter with phase-wound armature and field-system switching means to energize booster armature from transformer secondary.

1,318,701. METHOD OF SEARCHLIGHT VENTILATION; Elmer A. Sperry, Brooklyn, N. Y. App. filed April 3, 1916. Cools electrode holders and draws out fumes without causing flickering of arc.

1,318,713. CURRENT-COLLECTING DEVICE; Christian Aalborg, Wilkinsburg, Pa. App. filed Oct. 27, 1915. For ignition and lighting units.

1,318,722. COMBINED TARNSFORMER AND MAINTAINING REACTANCE DEVICE FOR VAPOR-CONVERTER SYSTEMS; Quincy A. Brackett, Pittsburgh, Pa. App. filed Aug. 30, 1916. Reactance with auxiliary inducing winding mounted on main core of transformer.

1,318,723. ELECTRICAL MEASURING INSTRUMENT; William M. Bradshaw, Wilkinsburg, Pa. App. filed March 8, 1917. Periodic power demands graphically recorded.

1,318,728. CONNECTOR; Frank Conrad, Pittsburgh, Pa. App. filed Dec. 26, 1913. For incandescent lamps on automobiles.

1,318,730. MEANS FOR MINIMIZING INDUCTIVE INTERFERENCE; Almon W. Copley, Wilkinsburg, Pa. App. filed Nov. 3, 1917. Confines return flow of power currents to rails.

1,318,734. DYNAMO-ELECTRIC MACHINE; G. M. Eaton, Pittsburgh, Pa. App. filed March 3, 1914. Form-wound coils for careful assembly and closeness of fit.

1,318,737. SWITCH FOR CONTROLLING ELECTRIC MOTORS; James Etchells and Clifford H. Stedman, Westminster, London, Eng. App. filed April 25, 1919. Single switch starts and reverses motor.

1,318,738. SYSTEM OF CONTROL; Ralph E. Ferris, Swissvale Pa. App. filed Feb. 4, 1916. Voltage constant through wide range of speed.

1,318,741. DYNAMO-ELECTRIC MACHINE; Erik Fornander, Wilkinsburg, Pa. App. filed April 1, 1915. Core members spaced apart and maintained in proper coaxial alignment.

1,318,744. MOTOR FRAME; David H. Friend, North Industry, Ohio. App. filed Aug. 7, 1916. Parts independently mounted.

1,318,746. PROCESS FOR HEATING, COOKING, ETC., BY MEANS OF ELECTRIC ENERGY; Oyven A. Grimnes, Baatsvik, near Risor, Norway. App. filed March 22, 1919. Superheated steam as medium between the electrically heated resistance and the body to be heated.

1,318,752. PHASE-CONVERTING SYSTEM; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed March 13, 1916. Dynamo-electric machine embodying quadrature-related primary and secondary stator windings and with a coil-type rotor winding employed for phase conversion may be started and accelerated to synchronous speed.

1,318,753. SYSTEM OF CONTROL: Rudolf E. Hellmund, Swissvale, Pa. App. filed Sept. 13, 1916. Automatic control of direct-current motors during regeneration.

1,318,754. SYSTEM OF CONTROL; Rudolf E. Hellmund, Swissvale, Pa. App. filed Aug. 7, 1917. Automatic governing of electric vehicle motors.

1,318,756. DYNAMO-ELECTRIC MACHINE; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed March 20, 1915. Converts single-phase trolley energy into ypolphase energy for driving motors.

1,318,755. CONTROL SYSTEM; Rudolf E. Hellmund, Swissvale, Pa. App. filed Sept. 25, 1914. Prevents flash-over in railway motors under predetermined conditions.

1,318,775. SPEED-CONTROLLING SYSTEM FOR INDUCTION MOTORS; Benjamin G. Lamme, Pittsburgh, Pa. App. filed Feb. 19, 1914. Frequency-changing apparatus adapted to regulate speed of induction motors.

1,318,779. ELECTRICAL SYSTEM; Walter O. Lum, Wilkinsburg, Pa. App. filed May 6, 1915. Motors successively reversed autotmatically.

1,318,784. CIRCUIT INTERRUPTER; Joseph N. Mahoney and Howard G. MacDonald, Wilkinsburg, Pa. App. filed Dec. 26, 1913. Manually and automatically tripping oil switch of large capacity.

1,318,787. IRON CORE FOR INDUCTION COILS; Johannes S. Mollerhoj, Frederiksberg, near Copenhagen, Denmark. App. filed March 12, 1919. Non-magnetic gap in each lamination.

1,318,832. METHOD OF EXHAUSTING; Wilfred T. Birdsall, Montclair, N. J. App. filed May 4, 1915. Walls highly heated electrically to remove gases.

1,318,838. ELECTRICAL HEATING UNIT; William A Braun, Canal Dover, Ohio. App. filed Dec. 15, 1915. Embedding material not injured by excessive heat.

1,318,853. DYNAMO-ELECTRIC MACHINE; Thos. R. DuBois, Niagara Falls, N. Y. App. filed April 22, 1916. For automobile starting.

1,318,855. METHOD OF AND APPARATUS FOR CONTROLLING ELECTRICAL ENERGY; Cornelius D. Ehret, Philadelphia, Pa. App. filed Nov. 15, 1918. For signaling, telephony or telegraphy.

1,318,874. ELECTROPNEUMATIC ACOUSTIC APPARATUS; Jurgen S. Hooghiemstra, Delft, Netherlands. App. filed July 10, 1919. Reinforces sounds of speech and musical tones.

1,318,886. RENEWABLE ELECTRIC FUSE; Frank C. La Mar and Peter J. Hopkins, Pittsburgh, Pa. App. filed June 20, 1918. Fusible element held in position by pressure of cap.

1,318,887. REFILLABLE ELECTRIC FUSE; Frank C. La Mar and Peter J. Hopkins, Pittsburgh, Pa. App. filed Aug. 16, 1918. Screw threaded projection on each end for holding cap.

1,318,937. TRANSMISSION-CONTROLLING MEANS FOR FOUR-WIRE REPEATERS; John F. Toomey, New York, N. Y. App. filed Oct. 16, 1917. Operating two distant stations connected by two separate transmission lines.

1,318,946. ELECTRICAL SYSTEM; Francis E. Wynne, Edgewood Park, Pa. App. filed Jan. 23, 1915. Prevents total power of alternating-current railway from exceeding specified maximum.

1,318,971. ELECTRICAL PROTECTIVE APPARATUS; Ira E. Cole, New York, N. Y. App. filed Sept. 21, 1917. For circuits of low normal operating voltage.

1,318,992. ELECTRODE HOLDER; Julius R. Hall, Oak Park, Ill. App. filed March 6, 1918. Adjustable.

1,318,993. ELECTROLYTIC CELL; Henry A. Hallum, Seattle, Wash. App. filed July 30, 1918. Acts as a negative pole and provides large area for hydrogen to be given off.

1,319,002. ELECTRIC HEATER; Prescott M. Hulbert, Detroit, Mich. App. filed Oct. 31, 1910. Protects carbon heating units from destruction by combustion.

1,319,008. OPERATING DEVICE FOR BRAKES, CLUTCHES AND THE LIKE; Charles B. Kind and Benjamin Jacoby, Marion, Ohio. App. filed June 18, 1917. Electrically operated device, whose circuit is controlled by the controller for the motor which drives the mechanism.

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1,319,036. APPARATUS FOR DETERMINING THE SPEED OF VEHICLES; Carl Barus, Providence, R. I. App. filed Aug. 12, 1918. Produces current proportional to acceleration.

1,319,068. SYSTEM OF RADIODIRECTIVE CONTROL; John Hays Hammond, Jr. Gloucester, Mass. App. filed June 15, 1912. Operates suitable apparatus on torpedoes or other movable bodies from the shore.

1,319,164. METHOD AND APPARATUS FOR THE TRANSFORMING OF ELECTRICAL ENERGY; Carl O. J. Montelius, Stockholm, Sweden. App. filed, April 11, 1918. Utilizes electrolytic condensers.

1,319,146. ALARM GAGE; Cassius M. Fisk, Napoleon, Ohio. App. filed Dec. 8, 1917. Circuit closed by action of float.

1,319,147. ELECTRIC BRUSH HOLDER; David B. Flower, Glenside, Pa. App. filed Jan. 9, 1917. For different sized machines.

1 319,181. MEANS FOR PRODUCING ELECTRICAL CURRENTS AND IMPULSES; George H. Sethman, Denver, Col. App. filed Oct. 26, 1914. Current induced by contraction of magnetic lines of force caused by breaking current in exciting coils.

1,319,191. MOTOR STARTER; Hermon L. Van Valkenburg, Milwaukee, Wis. App. filed Oct. 28, 1918. Produces different conditions during acceleration and after reaching normal speed.

1,319,215. BATTERY-CHARGING EQUIPMENT; Edward T. Foote, Boston, Mass. App. filed April 21, 1917. Assists operation of the resistance-controlling switch.

1,319,225. DYNAMO-ELECTRIC MACHINE; Chas. C. Kester and Clarence F. Gilchrist, Toledo, Ohio. App. filed June 25, 1917. Field-pole construction to reduce field distortion.

1 319,238. METHOD AND APPARATUS FOR STERILIZING AND PRESERVING MILK AND OTHER FLUIDS; Joseph F. Moscrop, Omaha, Neb. App. filed March 21, 1919. Utilizes flow of electricity transversely through layers of fluid.